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Preface

The Research Colloquium in Computer Sciences serves as a platform for final-year Bachelor of Computer Science students to exhibit their projects and research in three key fields: Information Technology (IT), Data Communication & Networking, and Netcentric Computing. This proceedings book compiles their work, reflecting their technical proficiency, problem-solving capabilities, and innovative thinking.

This colloquium not only provides an avenue for students to share their work but also fosters collaboration, critical thinking, and innovation within the computing community. We hope that this compilation serves as an inspiration for future students and researchers, encouraging continuous learning and advancement in the field of computer science.

We extend our appreciation to all contributors, including students, academic advisors, and examiners, for their efforts in making this event a success. Their commitment to excellence is evident in the quality of work presented in these proceedings.

Editors
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SMART SILENCE: A MOBILE APPLICATION FOR AUTOMATIC PHONE SILENCING DURING CLASS HOURS

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Abstract

Smartphone usage among university students often leads to classroom distractions caused by incoming calls, messages, and notification alerts. Although smartphones provide a Do Not Disturb (DND) feature, activation typically depends on manual configuration or fixed schedules that may not accommodate dynamic university timetables. This paper presents Smart Silence, a mobile application designed to automatically mute smartphones during class hours using schedule-based automation and GPS-based campus location detection. Users enter class schedules stored locally using SQLite, while GPS monitoring ensures silent mode activation only when the user is present on campus. The system was developed using Android Studio with Java programming language, following a simplified Waterfall methodology. Functional testing, performance testing, and User Acceptance Testing (UAT) were conducted to evaluate system reliability and usability. Results indicate that Smart Silence successfully automates the silencing process, reduces classroom interruptions, and is positively accepted by users. The application demonstrates the effectiveness of context-aware automation in improving responsible smartphone usage and enhancing the learning environment.

Keywords: Mobile application, Context-aware system, GPS automation, Usability testing, Smart learning environment

1 Introduction

Smartphones are widely used by university students for communication and academic activities, but uncontrolled notifications during lectures often disrupt classroom learning. Managing smartphone usage through intelligent digital solutions can improve engagement and reduce distractions (Kaminske et al., 2022). Requirement-driven mobile system design also ensures that applications effectively address user needs (Tanveer et al., 2023). However, built-in silent or Do Not Disturb (DND) features rely on manual activation or fixed scheduling that may not align with constantly changing academic timetables. Therefore, an automated system capable of controlling smartphone sound settings based on contextual information such as time and location, is required. This study proposes Smart Silence, a context-aware mobile application that automatically mutes smartphones during class hours using schedule-based automation combined with GPS-based campus detection.

2 Methodology

The Smart Silence application was developed using a simplified Waterfall approach consisting of requirement gathering, system design, development, and testing phases. Requirements were identified through literature review and analysis of student smartphone usage behaviour (Tanveer et al., 2023). The system architecture was designed using a layered architecture model to improve modularity and maintainability (Weichbroth, 2024). Functional testing procedures were derived from requirement specifications to ensure correct feature operation (Yu et al., 2025), while performance testing evaluated system responsiveness and operational stability under real-world mobile usage conditions (Tariq, 2025). The application was implemented using Android Studio with Java programming language and SQLite database, while GPS-based location detection enables automatic activation of silent mode when users are within campus boundaries.

3 Results / Findings

Testing results indicate that the Smart Silence application successfully performs automatic muting and unmuting functions according to defined class schedules and campus location conditions. Functional testing confirmed correct operation of schedule management, notification reminders, and location-based activation modules. Performance testing demonstrated stable application performance with acceptable response time and minimal resource consumption. User Acceptance Testing results showed that most participants found the application easy to use, useful in reducing classroom distractions, and suitable for daily academic use.

4 Novelty of Project / Product / Project

The novelty of Smart Silence lies in integrating schedule-based automation with real-time GPS-based campus detection to control smartphone sound behaviour intelligently. Unlike conventional DND scheduling features that rely solely on time, the proposed system activates silent mode only when both schedule and location conditions are satisfied, improving automation accuracy.

5 Conclusion or Future Work

Smart Silence provides an effective automated solution for managing smartphone notifications during lectures and improving student focus in academic environments. Future work may include integration with institutional timetable systems, cloud synchronization, and predictive scheduling to enhance system intelligence.

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ENCOURAGING GREEN INITIATIVE TO SUPPORT ECO-VARSITY USING GREEN GAMIFICATION

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Abstract

In the middle of escalating global climate challenges, higher education institutions serve as critical hubs for fostering sustainable practices through "Eco-Varsity" initiatives. However, existing sustainability campaigns at Universiti Teknologi MARA (UiTM) Arau suffer from a critical "Value-Action Gap," where student awareness fails to translate into consistent habits due to a lack of interactive feedback. This paper presents EcoXP, a native iOS mobile application that integrates Eco-Feedback Technology and Persuasive Design principles to digitize environmental stewardship. Developed using the Adapted Waterfall Model and Swift, the system leverages native frameworks specifically CoreLocation and MapKit to verify and log five distinct green activities. A four-week longitudinal pilot study with 11 university students demonstrated significant behavioural efficacy. The system achieved a 100% active retention rate, with the cohort cumulatively preventing over 300 kg of CO_2 emissions. Behavioural validation was further evidenced by a 25-day activity streak from the top-performing user and a Comparative Gap Analysis, where the mean score for "Self-Monitoring" rose to a perfect 5.00 post-intervention. These findings validate that mobile gamification successfully bridges the gap between passive environmental knowledge and active, verifiable sustainable behavior.

Keywords: Green gamification, Eco-feedback technology, Persuasive design, Behavior change, Campus sustainability

1 Introduction

Malaysia faces significant challenges in waste management and carbon reduction, with higher education institutions identified as key drivers for change. While Universiti Teknologi MARA (UiTM) Arau has implemented "Eco-Varsity" initiatives, these efforts are often hindered by the "Value-Action Gap" a psychological phenomenon where individuals possess environmental knowledge but fail to act on it due to a lack of motivation (Djafarova & Foerster, 2022). Traditional campaigns (posters, talks) lack the interactivity required to sustain long-term engagement among digital-native students. This project addresses this deficiency by introducing EcoXP, a system grounded in Eco-Feedback Technology digital tools that provide feedback on individual environmental impact to prompt behavior change (Froehlich et al., 2010). By integrating Persuasive System Design (PSD) principles such as self-monitoring and social comparison, the application aims to transform abstract environmental data into actionable, gamified experiences that bridge the gap between intent and action (Xue et al., 2023).

2 Methodology

This project adopted the Adapted Waterfall Model as the primary development lifecycle. According to Khan (2023), this model provides the necessary structure for defining rigorous requirements before code implementation. The application was developed natively for the iOS ecosystem using Swift, integrating CoreLocation and MapKit to implement "Geofenced Verification." To drive behavior change, the system architecture explicitly operationalizes Fogg's Behavior Model (FBM), ensuring that users have both the Ability (easy logging) and Trigger (notifications) to perform green actions. A longitudinal pilot study was conducted with

11 undergraduate students over a four-week period to measure the efficacy of these persuasive elements. Data was collected using a Pre-Test/Post-Test design, supplemented by real-time system logs to track frequency and retention.

3 Results / Findings

The study yielded significant quantitative and qualitative evidence of positive behavior change. First, regarding behavioural retention, the system achieved a 100% active retention rate, with participants logging activities daily or near-daily, and the top-performing user achieving a 25-day continuous streak. Second, in terms of environmental impact, the small cohort prevented approximately 300 kg of CO_2 emissions over four weeks. The data revealed that "Water Conservation" was the most adopted habit (55%), followed by "Reusable Containers." Finally, regarding user satisfaction, post-intervention surveys revealed a perfect Mean Score of 5.00 for the "Leaderboard" and "Guidance" features. Participants reported that social comparison was a primary motivator, proving that persuasive techniques like social pressure are effective drivers for sustainable habits.

4 Novelty of Project / Product / Project

EcoXP introduces three key innovations to the domain of campus sustainability. The primary novelty is Proof-of-Presence Verification, which utilizes Geofencing (CoreLocation) to algorithmically verify that a student is physically present at a green location before awarding points. The second innovation is Context-Aware Gamification, where the "Progress Tree" visualizes invisible carbon savings as a living digital entity to provide immediate psychological rewards. The third innovation is a Localized Carbon Algorithm, which uses a calculation logic calibrated specifically for the Malaysian campus context (e.g., local water dispenser usage metrics) rather than generic global standards.

5 Conclusion and Future Work

In conclusion, EcoXP successfully validates that Eco-Feedback Technology combined with Green Gamification can bridge the Value-Action Gap among university students. The perfect retention rates and high satisfaction scores confirm that digital persuasion is a powerful driver for sustainability. Future work will focus on porting the application to other mobile platforms to ensure inclusivity and integrating Machine Learning to automatically verify waste separation activities.

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REAL-TIME GEOLOCATION MOBILE APPLICATION FOR DOMESTIC SERVICES

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Abstract

Homeowners often face difficulties in identifying trustworthy and responsive domestic service providers, especially during urgent situations such as electrical faults, plumbing leaks, or structural damage. Safety concerns and delayed response times further increase the risks associated with traditional service hiring methods. This study presents the development of LocaServe, a Real-Time Geolocation Mobile Application for Domestic Services designed to connect homeowners with verified domestic service providers such as electricians, plumbers, and carpenters. The application integrates real-time location tracking to improve response time, accessibility, and transparency. The system was developed using a structured methodology and evaluated through functional and usability testing involving 31 homeowners and two expert domestic service providers. The findings indicate that the system operates effectively and is perceived as easy to use, learnable, and supportive of real service workflows. The study demonstrates that real-time geolocation technology can enhance trust, safety, and operational efficiency in domestic service delivery

Keywords: Real-time geolocation, Domestic services, Mobile application, Usability testing, Location-based services

1 Introduction

Home-related issues such as electrical faults, plumbing failures, and structural damage often require immediate professional assistance. However, homeowners frequently face difficulties in locating trustworthy and responsive domestic service providers within a short time frame, especially during emergencies (Aji et al., 2022). Existing service platforms mainly rely on scheduling-based systems, which are less effective in urgent situations as they do not prioritize proximity or real-time availability. In addition, the absence of transparent pricing mechanisms and proper provider verification raises concerns regarding safety and service reliability. The integration of real-time geolocation technologies, supported by GPS and Location-Based Services (LBS), offers an opportunity to improve service matching and dispatch efficiency. By leveraging accurate location tracking and availability data, a responsive and trustworthy domestic service platform can be developed. Therefore, this project proposes LocaServe, a real-time geolocation mobile application designed to connect homeowners with verified domestic service providers efficiently and securely.

2 Methodology

The system was developed using the Waterfall model to ensure structured progression through requirement analysis, system design, implementation, testing, and evaluation phases. Firebase was utilized for authentication and real-time database management, while the Google Maps API supported accurate location tracking. Functional testing was conducted through observation-based evaluation, where participants interacted directly with the application to validate core system operations. Usability testing was performed using an adapted System Usability Scale (SUS) questionnaire for homeowners and an expert-based usability review for domestic service providers. This combined evaluation approach aligns with structured usability assessment methods for mobile applications (Weichbroth, 2024).

3 Results / Findings

Functional testing confirmed that all core features, including registration, booking, real-time tracking, job management, and pricing calculation, operated according to system requirements. Scenario-based validation further demonstrated that the system effectively handled real-world conditions such as simultaneous booking requests and booking rejection management. Usability testing results indicated positive user perception across ease of use, learnability, workflow clarity, and user confidence. The majority of homeowners expressed willingness to reuse the application for domestic service needs. Expert domestic service providers confirmed that the workflow supports practical service operations, with only minor onboarding guidance required during initial use. These findings demonstrate that the system achieves satisfactory functional reliability and usability performance.

4 Novelty of Project

The novelty of this project lies in the integration of real-time geolocation with verified domestic service provider management within a localized service area. Unlike traditional scheduling-based platforms, LocaServe emphasizes on-demand service matching and real-time tracking. The inclusion of a structured pricing model incorporating distance and provider availability further enhances transparency. Additionally, the system implements scenario-based operational logic to address realistic service challenges such as multiple booking requests and provider rejection reasoning.

5 Conclusion

In conclusion, LocaServe successfully demonstrates the practical implementation of a real-time geolocation-based domestic service platform. The application enhances accessibility, safety, and efficiency in service delivery while maintaining positive usability performance for both homeowners and domestic service providers. Future work may include integrating secure real-payment gateways, expanding coverage beyond Arau, implementing automated provider prioritization algorithms, and enhancing intelligent booking recommendations using machine learning techniques.

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WOOD SURFACE DEFECTS DETECTION SYSTEM USING IMAGE PROCESSING TECHNIQUE

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Abstract

Manual timber grading is labor-intensive and error-prone, often compromising quality control in wood manufacturing. This study presents the Wood Surface Defects Detection System (WDDS), an automated solution using YOLOv8 deep learning to detect defects like knots and cracks with high precision. A custom dataset ensures reliability across varied wood textures. The system, deployed via a Streamlit dashboard, provides real-time analytics with bounding boxes and confidence scores. Testing shows accuracy exceeding 90%, with strong user approval for usability, offering a scalable, efficient alternative to traditional inspection methods.

Keywords: Wood defects, YOLOv8, Image processing, Deep learning, Timber grading

1 Introduction

Malaysia's timber industry relies heavily on surface quality for market value and export competitiveness. Defects such as knots, cracks, and discoloration reduce structural strength and aesthetic appeal. Manual inspection, still common in sawmills, is subjective, fatiguing, and inconsistent, leading to grading errors, material waste, and reputation damage. This project introduces an automated Wood Surface Defects Detection System using YOLOv8 for real-time, accurate defect detection, providing a cost-effective, intelligent solution to modernize quality assurance.

2 Methodology

The project follows three phases: Initiation identifies requirements and selects YOLOv8 for its speed and accuracy; a dataset of six defect classes (Knots, Cracks, Stains, Holes, Surface Roughness, Discoloration) is curated and augmented. Design and Development includes preprocessing, transfer learning training on YOLOv8m, and deployment in a user-friendly Streamlit dashboard. Evaluation measures performance via mAP, Precision, Recall, F1-Score, and conducts User Acceptance Testing (UAT) with experts and general users using Likert-scale questionnaires.

3 Results / Findings

The WDDS achieves mAP@0.5 of 0.812 and mAP@0.5:0.95 of 0.547, with consistent loss reduction and model convergence. Usability testing (3 experts, 25 normal users) shows 100% task completion and high scores: Accuracy/Technical Reliability (4.415), Practicality/Clarity (4.572), UX/Learnability (4.22). 90% of users would recommend the system, confirming its reliability, real-time performance, and ease of use.

4 Novelty of Project / Product / Project

This project delivers an accessible, real-time wood defect detection system using YOLOv8 on consumer hardware, eliminating the need for costly scanners. It integrates an intuitive Streamlit dashboard with an educational Encyclopedia, session history, and CSV export features, democratizing quality assurance for SMEs and non-experts in Malaysia's timber sector.

5 Conclusion or Future Work

The developed system enables reliable, efficient wood grading, reducing human error and waste. Future enhancements include PLC and robotics integration for automated sorting and pixel-level segmentation for precise cutting to maximize material recovery.

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SPEECH EMOTION RECOGNITION FOR DETECTING EMOTIONS AMONG UNIVERSITY STUDENTS

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Abstract

University students often experience emotional challenges arising from academic pressure and social demands, which may negatively affect their mental well-being and academic performance. To address the limitations of subjective emotion assessment methods, this project develops a desktop-based Speech Emotion Recognition (SER) prototype that identifies emotional states from speech, thereby promoting emotional awareness among university students. The prototype focuses on four primary emotions: happiness, sadness, anger, and neutrality while also employing a Convolutional Neural Network (CNN) trained on the RAVDESS dataset using Mel-Frequency Cepstral Coefficients (MFCCs). The trained model is integrated into a real-time desktop application that enables live audio capture, emotion prediction and visual feedback through an interactive interface. Experimental evaluation demonstrates that while the baseline CNN achieves slightly higher overall accuracy (86.36%), the hyperparameter-tuned CNN improves class-specific precision for certain emotions, highlighting a trade-off between generalization and selective emotion recognition (85.71%). Overall, the proposed SER prototype shows strong potential as a supportive tool for enhancing emotional awareness and early mental health intervention in university settings.

Keywords: Speech Emotion Recognition, CNN, Emotion Detection, University Students, MFCC

1 Introduction

Emotions play an important role in students' academic performance and overall well-being, especially in higher education environments where academic pressure and social demands are common. Emotional states such as stress, anxiety, and disengagement can negatively affect learning outcomes and academic satisfaction. Previous studies highlight the importance of monitoring students' emotional conditions because emotions significantly influence academic performance, motivation and engagement (Hachem et al., 2022). Speech Emotion Recognition (SER) has emerged as a non-intrusive approach for detecting emotions through vocal characteristics such as pitch, tone, and speech rhythm. Therefore, this study presents a desktop-based SER prototype designed to identify emotional states using speech signals to promote emotional awareness and mental well-being.

2 Methodology

The development of the Speech Emotion Recognition (SER) prototype followed a structured methodology consisting of requirement identification, model development, and performance evaluation phases. The RAVDESS dataset was selected due to its high-quality emotional speech recordings under controlled conditions. Speech signals were pre-processed through noise reduction, amplitude normalization, framing, and voice activity detection to improve signal quality. Acoustic features were then extracted using Mel-Frequency Cepstral Coefficients (MFCCs) together with delta and delta-delta derivatives to capture both spectral and temporal emotional characteristics. This processing pipeline follows the standard SER framework involving speech acquisition, feature extraction, and neural network classification (A.V. Tsaregorodtsev et al., 2022). A Convolutional Neural Network (CNN) model was implemented for emotion classification, with hyperparameter tuning performed using Keras Tuner Random Search to optimize model parameters. The trained model was then integrated

into a Python-based desktop application using Tkinter to enable real-time speech input, emotion prediction, and interactive visualization.

3 Results and Findings

The developed prototype successfully detected four emotional states, namely happiness, sadness, anger, and neutral, from real-time speech input. Performance evaluation was also conducted using the standard performance metrics method. The baseline CNN model achieved an overall accuracy of 86.36%, which indicates a strong general classification capability. The hyperparameter-tuned model demonstrated improved precision for specific emotion classes, although with slightly reduced overall accuracy of 85.71%. Confusion matrix analysis then showed occasional misclassification between emotions such as anger and happiness due to similarities in vocal patterns and dataset limitations.

4 Novelty of Project

The novelty of this work lies in the development of a lightweight desktop-based Speech Emotion Recognition prototype. Unlike many SER studies that focus mainly on model performance, this project integrates the trained CNN model into a practical real-time application with an interactive graphical interface. The prototype processes speech locally without relying on cloud services, which supports privacy considerations while maintaining usability. Additionally, limiting the prototype to key emotions improves efficiency and makes it more practical for educational use, particularly for supporting student emotional awareness and mental health monitoring.

5 Conclusion or Future Work

This study successfully developed a Speech Emotion Recognition prototype capable of detecting emotional states through speech signals. The integration of CNN-based classification into a real-time desktop application demonstrates the feasibility of emotion-aware educational tools. The prototype achieved reliable performance while highlighting the potential of SER technology for promoting emotional awareness in academic environments. Future work may involve expanding datasets with real-life student speech recordings, incorporating additional emotional categories, improving robustness under noisy conditions, and exploring multimodal emotion recognition approaches that combine speech with facial or physiological signals.

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PLANPREP – A MOBILE APP FOR PERSONALIZED MEAL PLANNING

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Abstract

Finding healthy food while managing a busy schedule is a significant challenge for students and working individuals, often resulting in poor eating habits and decision fatigue. While many meal planning applications exist, they are often characterized by complex structures and cluttered designs that do not meet the needs of users seeking simplicity. This paper presents PlanPrep, a mobile application designed to simplify the meal planning process by adapting to the specific lifestyles and preferences of its users. By using an Adapted Waterfall model and Android Studio and Firebase for development, the application focuses on user-centered design to reduce cognitive load. A User Acceptance Test (UAT) involving 30 respondents indicated high levels of satisfaction, with a mean score of 4.57 for Perceived Ease of Use. The results suggest that PlanPrep effectively assists users in maintaining structured healthy eating habits despite time constraints.

Keywords: Mobile application, Personalized meal planning, User-centered design, Time management, User acceptance test

1 Introduction

In the modern era, mobile devices have evolved into essential tools for personal productivity and health management. Despite the proliferation of health-related apps, many individuals, particularly students and working adults, struggle to prepare healthy meals due to hectic schedules. Research indicates that a lack of time is a primary factor contributing to dependency on fast food and long-term health issues. Furthermore, the mental burden of making daily on-the-spot meal decisions leads to decision fatigue, which further diminishes dietary quality. Existing applications often fail the targeted user groups by providing overly complex features like nutritional intake analysis and calorie counting, which add to the user's cognitive strain. PlanPrep addresses these gaps by offering a simplified, user-friendly interface that prioritizes efficiency and adaptability to individual dietary preferences.

2 Methodology

This study employed an Adapted Waterfall Model, which segmented the development process into three distinct phases: Requirement Identification, Design and Development, and Testing and Evaluation. In the initial phase, requirement gathering was conducted through surveys aimed at the target demographic of students and working professionals to identify functional needs and specific pain points related to time constraints and decision fatigue. The subsequent phase involved the design and development of the PlanPrep mobile application using Android Studio and Firebase, guided by User-Centered Design (UCD) principles to ensure simplicity and ease of navigation. System architecture was defined using Level 0 Data Flow Diagrams (DFD) and hierarchy diagrams to ensure robust data management and seamless interaction between the meal planning, grocery list, and user profile modules. The final phase focused on evaluating the application's functionality and usability through a structured User Acceptance Test (UAT) with real-world users.

3 Results / Findings

The results of the User Acceptance Test (UAT), which involved 30 participants comprising 19 students and 11 working adults, demonstrated significant acceptance and satisfaction with the application. The findings revealed high user satisfaction, particularly in the category of Perceived Ease of Use (PEU), which achieved a mean score of 4.57, indicating that the majority of users found the interface intuitive and could utilize the features independently without assistance. Regarding Perceived Usefulness (PU), the application received a high mean score of 4.40 for its ability to enhance the effectiveness of the meal planning process, while scores of 4.17 were recorded for its impact on daily productivity and time management. Additionally, the overall Attitude (ATT) towards the application registered a mean score of 4.47, reflecting a high level of agreement that PlanPrep effectively reduces the mental load of meal planning and helps users maintain more structured healthy eating habits.

4 Novelty of Project / Product / Project

Unlike existing applications that focus heavily on calorie tracking and data-heavy metrics, PlanPrep introduces novelty through its lifestyle-based filtering and simplified automation. Users can categorize their daily routines (e.g., hectic vs. relaxed) and set allergy filters to automatically refine meal suggestions. Additionally, the "Copy Yesterday" and "Surprise Me" features allow for instant plan generation, significantly reducing the mental effort required for daily meal management.

5 Conclusion or Future Work

In general, the developed application successfully met its objectives by identifying user requirements, creating a functional personalized planning tool, and achieving positive evaluation results. Future work will focus on expanding the recipe database, improving feature integration, and increasing application availability across different mobile platforms to further support healthy lifestyle habits

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I-TRAVEL: A PERSONALIZED TRAVEL PLANNER MOBILE APPLICATION

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Abstract

Planning and organizing travel can be challenging for both students and working adults due to time constraints, information overload, and limited personalization in existing travel applications. Most current travel platforms primarily focus on booking and reservations, offering minimal support for self-organized and preference-based trip planning. This paper presents *I-TRAVEL*, a personalized travel planner mobile application designed to assist users in organizing trips efficiently based on individual mood, preferences, location, and real-time weather conditions. The application was developed using the Waterfall methodology, covering requirement analysis, system design, development, and testing phases. Android Studio was used as the development environment, with Firebase serving as the backend database. The evaluation involved a User Acceptance Test (UAT) with 31 respondents comprising university students and working adults, along with functional testing conducted by two expert users. The results demonstrate a high level of user acceptance, particularly in terms of ease of use, usefulness, and overall satisfaction. Functional testing further confirmed that the application performed reliably across its core features. The findings indicate that I-TRAVEL effectively supports personalized and structured travel planning while reducing the complexity of manual trip organization.

Keywords: Itinerary planning, Mobile application, Mood-based recommendation, Personalized travel planner, User acceptance testing

1 Introduction

The widespread use of smartphones has transformed travel planning by providing easy access to information and navigation; however, many existing travel applications focus mainly on booking services and offer limited personalization and self-organization support. This often leads to disorganized itineraries and information overload for travelers. To address these limitations, this study proposes I-TRAVEL, a personalized travel planner mobile application that integrates mood-based recommendations, real-time weather information, navigation, and planning tools to enhance the efficiency and flexibility of travel planning.

2 Methodology

This study adopted the Waterfall development methodology, consisting of requirement analysis, design, development, and testing phases, to ensure a systematic and structured approach to application development. User requirements were identified through literature review and analysis of existing travel applications, followed by the design of user interfaces, data flow diagrams, hierarchical diagrams, and sitemap structures using Figma. The application was developed using Android Studio, with Firebase utilized for authentication and database management, and evaluated through a User Acceptance Test involving 31 respondents and functional testing conducted by two expert users to assess usability, acceptance, and system reliability.

3 Results / Findings

The results from the User Acceptance Test indicate a high level of acceptance across all evaluation criteria, particularly perceived ease of use, perceived usefulness, and overall satisfaction, suggesting that users were able to understand and operate the application with

minimal difficulty. Functional testing further confirmed that all core features, including mood-based recommendations, map navigation, weather integration, and item checklist management, functioned as intended without critical errors, demonstrating that the developed application meets its functional requirements and effectively supports self-organized travel planning.

4 Novelty of Project / Product / Project

The novelty of the I-TRAVEL application lies in its integration of mood-based travel recommendations, real-time weather data, personalized itinerary planning, and self-organization tools within a single mobile platform, distinguishing it from existing travel applications that primarily focus on booking services. By emphasizing user preferences, emotional context, and practical preparation features, I-TRAVEL offers a more flexible, personalized, and user-centered approach to travel planning.

5 Conclusion or Future Work

In conclusion, the I-TRAVEL mobile application successfully achieves its objective of providing a personalized and organized travel planning solution, as evidenced by positive user acceptance and reliable system performance. Future enhancements may include improving personalization algorithms, expanding destination coverage, and integrating advanced intelligent features such as artificial intelligence–based recommendations to further enhance usability, scalability, and user experience.

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TALKSPHERE: AN INTERACTIVE MANDARIN LANGUAGE LEARNING WEB PLATFORM INTEGRATING WITH AUGMENTED REALITY

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Abstract

Traditional Mandarin language instruction in Malaysia's multilingual higher education context often relies on textbook-based methods that limit contextual application and learner engagement. This paper presents TalkSphere, an interactive web-based platform integrating Augmented Reality (AR) to enhance Mandarin vocabulary learning among UiTM students. Developed using Agile methodology, the system incorporates vocabulary modules, quizzes with three difficulty levels, progress tracking, and marker-based AR features that display 3D models upon scanning QR codes. The platform was evaluated through expert-based functionality testing (n=2) and the User Experience Questionnaire (UEQ) involving 30 UiTM students learning Mandarin as a third language. Functionality testing confirmed that all core features – authentication, navigation, vocabulary learning, quiz system, AR scanning, and progress tracking- operated reliably with no critical errors. UEQ results revealed positive perceptions across attractiveness, perspicuity, stimulation, and dependability dimensions. Users found the interface visually appealing, easy to navigate, and motivating for beginner learners. However, the novelty dimension received moderate scores, indicating opportunities for enhanced innovation. Minor usability improvements, including opportunities for enhanced innovation. Minor usability improvements were implemented based on feedback. This project demonstrates that integrating AR into web-based language learning platforms can effectively bridge the gap between theoretical knowledge and practical application, offering an engaging and user-centered supplement to conventional Mandarin instruction.

Keywords: Augmented reality, Mandarin language learning, Web-based learning platform, User experience

1 Introduction

Mandarin learning in Malaysia faces challenges due to traditional textbook-based approaches that limit contextual practice. Although AR has shown potential in enhancing vocabulary retention and motivation, limited research focuses on AR-based Mandarin learning in Malaysian higher education.

2 Methodology

This study adopted Agile methodology with iterative development phases: planning, design, development, testing, review, and documentation. TalkSphere was developed as a web-based platform integrated with QR-based AR. Evaluation involved expert functionality testing and UEQ assessment by 30 UiTM students.

3 Results / Findings

Expert evaluation confirmed that all core features functioned reliably (ratings 4–5/5) with no critical bugs. UEQ results showed positive user perceptions, particularly in attractiveness and perspicuity, while efficiency and novelty indicated room for enhancement.

4 Novelty of Project / Product / Project

TalkSphere integrates web-based learning with QR-linked AR visualization without requiring additional applications. It combines contextual vocabulary learning, gamification, and localized content tailored to UiTM students, supported by an educator analytics dashboard.

5 Conclusion or Future Work

This paper presented TalkSphere, a web-based Mandarin learning platform integrated with Augmented Reality to enhance engagement and contextual vocabulary application. The system translated identified learner needs into a reliable, user-centered platform featuring interactive vocabulary modules, audio support, gamification, and AR visualization. Evaluation results indicated positive user experience outcomes and strong functional performance with no critical errors. However, the system currently focuses on beginner-level vocabulary, limiting advanced applicability. AR performance depends on stable internet and lighting conditions, and the evaluation sample was limited to 30 participants, restricting broader generalization.

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TASKMIND: PERSONAL TASK MANAGER WITH SMART REMINDER FOR UNIVERSITY STUDENTS

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Abstract

Academic procrastination and high levels of psychological stress are prevalent among university students due to heavy academic workloads and conflicting deadlines. This paper presents the development of TaskMind, a mobile application designed to provide a personalized task management experience through an intelligent priority-based scoring system and a customized reminder framework. The project adopted the Design Science Research Methodology (DSRM), spanning five distinct phases from problem awareness to evaluation. The application was developed using the Flutter framework and Firebase for real-time data management. To assess the system, User Experience Testing (UXT) was conducted with 30 university students using the User Experience Questionnaire (UEQ). Results indicated "Excellence" levels across five dimensions: Efficiency (2.317), Stimulation (2.292), Attractiveness (2.250), Perspicuity (2.158), and Dependability (2.142). The findings suggest that TaskMind effectively simplifies decision-making and reduces cognitive load by automating task prioritization. This study contributes a specialized tool for the academic environment, addressing the specific organizational needs of students to improve productivity and mental well-being.

Keywords: Task management, Smart reminders, University students, Priority scoring, DSRM

1 Introduction

University students frequently face challenges in balancing classes, assignments, social activities, and part-time work, often leading to stress and diminished academic performance. Traditional task management methods, such as sticky notes or manual planners, often fail to address the dynamic and complex nature of student life. While many digital task managers exist, they often lack the intelligence to adapt to academic schedules or provide reminders that are sensitive to task priority. Many systems utilize rigid clocks that ring regardless of task importance, leading users to disregard or snooze alerts. TaskMind addresses these gaps by offering a student-oriented tool that utilizes personalized task processing and adaptive, smart reminders to enhance productivity and well-being.

2 Methodology

This study used the Design Science Research Methodology (DSRM), an iterative five-stage process.

- Awareness of Problem: Data was collected from publications, journals, and direct user input to identify the core challenges in student task management.
- Suggestion: Potential solutions were recommended based on a review of productivity tools and time-management theories.
- Design and Development: TaskMind was developed as a multi-platform application using a document-oriented architecture for Firestore.
- Evaluation: Functional testing and User Experience Testing (UXT) were conducted with 30 respondents to measure the system's effectiveness and usability.
- Conclusion: Results were documented to validate the achievement of research objectives.

3 Results / Findings

The findings of this study show that the evaluation of TaskMind yielded highly positive quantitative data. Based on the UEQ analysis, the application achieved scores ranging between 2.0 and 2.5 on a scale of -3 to +3, placing it in the "Excellence" category compared to industry benchmarks. Specifically, the Efficiency scale scored the highest (2.317), proving that the application allows users to complete tasks quickly and with minimal effort. Stimulation (2.292) and Attractiveness (2.250) scores further indicate that students found the app motivating and visually appealing.

4 Novelty of Project

This mobile application that uses a Smart Priority Algorithm that automatically ranks tasks based on academic weight, time remaining, and user-defined importance. Unlike standard list-making apps, it features a Metacognitive Planning requirement where students estimate task duration, which enhances the precision of the priority score. Additionally, the integration of a Timetable Page allows for context-aware notifications that avoid conflicts with scheduled classes

5 Conclusion or Future Work

In general, the developed application TaskMind is an effective solution for reducing academic procrastination and enhancing time management among university students. Future work will focus on API integration with Learning Management Systems (LMS) like Google Classroom or Canvas to automate assignment tracking. Additional recommendations include introducing sub-task functionality for complex projects and expanding the participant demographic for broader validation.

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STACKT: A UNIVERSITY EXPENSE TRACKER APP WITH GEOLOCATION, PARENTAL MONITORING, AND RECEIPT SCANNER

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Abstract

University students in Malaysia frequently encounter financial difficulties driven by unrestrained spending and a fundamental lack of financial literacy. Utilizing the Adaptive Waterfall Methodology, this project involved the development of "STACKT" using Android Studio, Firebase, and specialized APIs. The application integrates a geolocation expense tracker, a parental monitoring module, and an Optical Character Recognition (OCR) receipt scanner. Testing phase results indicated positive reception: Perceived Ease of Use at 4.14 and Perceived Usefulness at 4.26. Ultimately, STACKT serves as a practical foundation for improving student financial health.

Keywords: Expense Tracker, Geolocation, Parental Monitoring, OCR Scanner, Financial Literacy

1 Introduction

In the current era, 97.6% of Malaysian households prefer smartphones, and consumers are increasingly reliant on mobile applications (Department of Statistics Malaysia, 2024). Traditional expense tracking methods like paper records are often ineffective and prone to human error (Ramya & Lipsa, 2025). The shift toward a cashless society has become a challenge where students may spend impulsively without proper budgeting. This project proposes "STACKT", a mobile application designed to help university students strategize their expenses using geolocation and monitoring modules. STACKT serves as a starting step for students to improve financial literacy.

2 Methodology

This project adopted the Adapted Waterfall Model to ensure structured implementation. The methodology consists of three main phases: requirement gathering, system design and development, and testing. During requirement gathering, literature reviews identified financial challenges such as overspending and ineffective manual tracking. In the development phase, Android Studio was used as the primary environment, with Firebase for database management and external APIs for OCR and geolocation. The final phase involved User Acceptance Testing (UAT) and functionality testing to assess usability and performance.

3 Results

STACKT was evaluated using Use Acceptance Testing (UAT) involving university students to measure usability and acceptance levels. The evaluation was structured into four constructs. Perceived Ease of Use (PEU), Perceived Usefulness (PU), Attitude (ATT), and Behavioural Intention (BI), where the results demonstrated positive with mean scores of 4.14 for PEU, 4.26 for PU, 4.16 for ATT, and 4.75 for BI. These findings indicate that users found in STACKT easy to operate, useful for financial management, and beneficial in improving awareness of their spending habits. Functionality testing confirmed all core modules, such as the receipt scanner, geolocation, and parental monitoring, operate as intended without system failure.

Minor improvements were suggested in the navigation flow for first-time users. Overall, the findings validate the effectiveness of STACKT in assisting students in tracking their expenses more effectively.

4 Novelty of Project

The novelty of STACKT lies in the integration of three main modules within a single mobile platform. Unlike other expense tracker applications that focus on manual expense logging, STACKT combines geolocation features as a reminder feature, receipt scanning through OCR, and a parental monitoring module that enables supervised financial awareness. The incorporation principles are inspired by Theory of Planned Behaviour to differentiate this application by targeting behavioural changes rather than simple transaction recording (Ajzen, 1991). Additionally, the application provides these features without any subscriptions, which would make it more accessible to students. This integration and student-focused approach would address the limitation identified in the existing expense tracking application.

5 Conclusion and Future Work

In conclusion, STACKT was successfully designed and developed as a structured financial management tool which are aimed to improve budgeting discipline among university students. Through integrating a receipt scanner, geolocation, and monitoring features, the application provides a solution to common financial issues faced by students. Evaluation results demonstrated strong user acceptance and confirmed STACKT's usability and effectiveness. While STACKT achieved the intended objectives, future enhancements may include cross-platform development to support iOS devices, and direct integration with the banking system could enable real-time data logging. These improvements would enhance automation, accuracy, and long-term adoption potential.

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OUTFIT RECOMMENDER APPLICATION USING IMAGE RECOGNITION FOR MODEST STYLE

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Abstract

Selecting outfits every day can be a challenge for everyone, especially Muslim women who want to be stylish, modest, and emotionally self-confident. Most of the fashion applications that are currently available fail to support the concept of modest fashion. This project is filling this gap through building a mobile outfit recommender system to help users in managing their wardrobe and generate modest outfit recommendations through image recognition and recommendation logic. The system was developed following the CRISP-DM methodology. A deep learning model with transfer learning was trained on DeepFashion2 data that was based on ResNet50. The model categorized clothing pictures based on the category of clothing, like tops, bottoms, dresses, and outerwear, and determined the level of modesty. The trained model was implemented using FastAPI and a Google Cloud Run instance and embedded in a React Native-based mobile application created with Expo. User wardrobe data and outfit records were stored in the users' local storage using SQLite. The system adopted a hybrid approach of recommendation, which integrated deep learning-based classification and rule-based outfit generation to ensure they met the modest fashion principles and the occasion demands. The principles of emotional design were applied with a friendly and supportive user interface that improved the user interaction and decision-making. The classification model achieved approximately 78-79% accuracy. The testing on the usability and functionality showed that the system was quite helpful with planning the outfits practical and intelligent solution for modest outfit recommendations.

Keywords: Modest fashion, Image recognition, ResNet50, Hybrid recommendation, Emotional design

1 Introduction

Dressing properly can be challenging for Muslim women who need to balance modesty, comfort, and personal style, which may affect confidence and decision-making (Mandal & Kumar, 2022; Nwonye et al., 2024). Managing multiple clothing items can also be difficult. Most fashion applications focus on shopping or general styling and do not support modest fashion needs or personal wardrobe management (Baristiene & Kandzeras, 2022). ResNet50, a Convolutional Neural Network, has shown strong performance in image classification, while rule-based systems generate structured recommendations using logical rules (Sarker, 2021). Therefore, this project developed a mobile outfit recommender system using image recognition and hybrid recommendation logic.

2 Methodology

The system was designed in accordance with the CRISP-DM methodology that offers a structured cycle of steps such as data preparation, modeling, evaluation, and deployment (Schröer et al., 2021). The image classification model was trained on DeepFashion2 dataset since it has detailed annotations of clothes. Image preprocessing involved bounding box cropping of clothing areas, resizing of images to 224 x 224 pixels, and pixel normalization. Transfer learning was used to train a ResNet50V2 model to categorize clothing items into tops, bottoms, dresses, and outerwear, and to determine the modesty level. FastAPI was used to deploy the trained model to Google Cloud Run, which enabled real-time classification by using the API. React Native and Expo were used to develop the mobile application and store

wardrobe data locally using SQLite. A hybrid recommendation system was used that combined the results of classification with rule-based logic to produce outfits.

3 Results / Findings

The trained model was about 78-79% accurate in classification, meaning that it was reliable in clothing recognition. The images were processed successfully by the FastAPI backend, and the classification results were sent back to the mobile application. It was then saved in SQLite, and the recommendation engine was applied in order to provide outfit recommendations. Functionality testing ensured that the system was functional, i.e., it could upload images, classify them, store them in the wardrobe, and generate recommendations. The usability testing revealed that the users could manage their wardrobe more easily and find combinations of outfits when choosing outfits.

4 Novelty of Project

This project is unique as it combines the concept of deep learning classification, rule-based recommendation logic, and emotional design into a modest fashion-oriented mobile application. It is not a regular fashion application, but it interacts directly with the wardrobe of the user and provides recommendations depending on the principles of modesty. The FastAPI and Google Cloud Run deployment allow real-time classification with a scalable cloud backend.

5 Conclusion or Future Work

The fashion mobile outfit recommender system was able to incorporate image recognition, hybrid recommendation logic, and mobile application technology to serve modest fashion users. The system was capable of categorizing clothing and wardrobe information and producing modest outfits. The future development can involve enhancing model accuracy with more data, cloud synchronization, and personalization according to user preferences.

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DIABETES MELLITUS: INTEGRATING DATA WITH INTERACTIVE VISUALIZATION FOR PUBLIC AWARENESS

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Abstract

This study addresses the challenges of low public awareness and complex medical datasets in diabetes management by developing an interactive Big Data dashboard using Microsoft Power BI. Following a structured development methodology and utilizing data from Kaggle and the NCD Risk Factor Collaboration, the project aims to streamline real-time health monitoring and simplify complex information. Evaluation via the Technology Acceptance Model (TAM) yielded high mean scores (4.24–4.30), indicating strong user perceived usefulness and ease of use. The results demonstrate that the dashboard effectively bridges the gap between big data and public health literacy, offering a scalable framework for predictive modeling and personalized preventive healthcare management.

***Keywords**: Diabetes Mellitus, Big Data Analytics, Interactive Dashboard, Technology Acceptance Model (TAM), Public Health Literacy*

1 Introduction

Maintaining good health is crucial to reducing the risk of chronic diseases, such as diabetes (Kuwahara et al., 2022). In 2025, it was reported that one in nine adults aged 20 to 79 years is living with diabetes worldwide, and four out of ten individuals remain unaware that they have the condition (International Diabetes Federation, 2025).This alarming trend highlights the growing global burden of diabetes. Diabetes mellitus is defined by the World Health Organization (2025) as a chronic disease characterized by elevated blood glucose levels, which, if left uncontrolled, can lead to progressive damage to the heart, blood vessels, kidneys, and nerves. Furthermore, studies have shown that diabetes adversely affects bone metabolism, resulting in reduced numbers of bone-lining cells and osteoblasts, as well as periodontal ligament fibroblasts (Kitaura et al., 2021).

2 Methodology

The methodology for this project followed a structured, five-phase Waterfall approach: planning, analysis, design, development, and testing to create an interactive diabetes mellitus visualization dashboard. During the planning and analysis phases, the project scope was defined, and a comprehensive literature review was conducted. Data was collected from Kaggle and the NCD Risk Factor Collaboration. In the design phase, the system's architecture was established through data modeling. The development phase centered Extract, Transform, Load (ETL) process using Python and Apache Hive to clean and manage large datasets. These processed datasets were then integrated into Microsoft Power BI to generate interactive visual reports and embedded into a web-based platform developed via Wix. Finally, the testing phase involved a User Acceptance Test (UAT) with 30 respondents using the Technology Acceptance Model (TAM). This evaluation confirmed high mean scores across all dimensions exceeding 4.0, validating the system's effectiveness in enhancing public awareness.

3 Results / Findings

The findings and analysis of this study reveal that the "DiabetesMellitus" interactive dashboard is a highly effective tool for enhancing public health literacy, as evidenced by positive user feedback across all evaluated dimensions. Evaluation through the Technology Acceptance Model (TAM) with 30 respondents, overall mean score of 4.27. Specifically, users' rate PEU at 4.25, indicating development intuitive and requires minimal mental effort to navigate. PU achieved a mean of 4.30, highlighting the platform's value in discovering new insights and supporting future healthcare decisions. User Attitude at 4.30, as respondents expressed satisfaction with the design and felt the tool significantly assisted in lifestyle management for diabetes prevention. Finally, the IU score of 4.24 reflects a strong likelihood that users will adopt the platform for long-term health monitoring and recommend it to others.

4 Novelty of Project / Product / Project

The novelty of this project lies in its seamless integration of Big Data analytics, predictive modeling, and interactive visualization within a unified web-based dashboard specifically tailored for diabetes mellitus. While existing systems often provide either high-accuracy machine learning predictions without user-friendly interfaces or static visual dashboards lacking predictive depth, this study bridges that gap by offering a comprehensive platform for both clinical and non-clinical users. A key unique feature is the use of Apache Hive and Hadoop to process massive health datasets from sources like Kaggle and the NCD Risk Factor Collaboration, which are then transformed into dynamic, real-time visual insights using Microsoft Power BI.

5 Conclusion or Future Work

This project has successfully achieved its core objectives by designing and developing a user-friendly interactive dashboard that integrates big data and predictive analytics to enhance diabetes awareness. Evaluation through the Technology Acceptance Model (TAM) mean scores across all dimensions exceeding 4.0, confirming the system's effectiveness in simplifying complex health data into actionable visual insights. However, some limitations include a reliance on specific datasets which may restrict generalizability. Future work should focus on integrating real-time data streams from clinical sources to support dynamic monitoring. Additionally, incorporating more sophisticated machine learning architectures and expanding the dashboard's scope to include a wider variety of diabetes types and individualized medical histories will further refine its predictive precision and clinical utility.

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A DEEP LEARNING APPROACH FOR KENAF DISEASE IDENTIFICATION USING MOBILENETV2

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Abstract

Kenaf (*Hibiscus cannabinus L.*) is an important industrial crop that supports eco-friendly manufacturing and sustainable agriculture in Malaysia. However, Kenaf productivity is frequently reduced by leaf diseases that are difficult to detect early using conventional manual inspection. Misdiagnosis often leads to yield loss and inefficient pesticide use. This study proposes an automated Kenaf leaf disease detection system using deep learning techniques. A Convolutional Neural Network (CNN) based on the MobileNetV2 architecture is selected due to its lightweight design and high classification efficiency. A dataset of 1,550 Kenaf leaf images was collected from Ladang Kenaf Chuping, Perlis, and categorized into healthy, Leaf Blight, Tungau, and *Sundapteryx bigutulla*. The dataset underwent preprocessing, normalization, and augmentation before model training using transfer learning. The system was evaluated using accuracy, precision, recall, and F1-score metrics. The trained model was then integrated into a web-based dashboard that allows real-time disease prediction and visualization. Experimental results demonstrate strong classification performance and reliable disease detection capability. Usability testing with expert and normal users confirms that the system is practical, intuitive, and suitable for real agricultural environments. This research contributes to precision agriculture by providing an efficient and scalable AI-based solution for Kenaf disease monitoring and crop management.

Keywords: Kenaf disease detection, MobileNetV2, deep learning, CNN, precision agriculture

1 Introduction

Kenaf is a high-value industrial crop widely used in textile, packaging, and biodegradable material production. Despite its economic significance, Kenaf plants are vulnerable to leaf diseases that significantly affect crop yield and fibre quality. Previous research has explored convolutional neural networks for detecting disease and pests in Kenaf plants (Fajri et al., 2021). Current disease detection methods rely heavily on visual inspection by farmers, which is subjective, time-consuming, and prone to error. Deep learning, particularly CNN-based approaches, has demonstrated strong performance in image-based plant disease classification (Mohanty et al., 2016). Lightweight architectures such as MobileNetV2 are suitable for agricultural deployment due to their computational efficiency (Sandler et al., 2019). This study aims to develop an automated Kenaf disease detection system that improves diagnostic accuracy while remaining practical for real-world use.

2 Methodology

The research was conducted in three phases: requirement identification, system construction, and system evaluation. A field dataset containing 1,550 Kenaf leaf images was collected and labeled with expert verification. Images were resized to 224×224 resolution, normalized, and augmented using rotation and flipping techniques to enhance generalization. Transfer learning was applied using the MobileNetV2 architecture to improve performance with limited training data (Pan & Yang, 2010). Training was performed in two stages: feature extraction and fine-tuning. Performance evaluation used standard classification metrics including accuracy, precision, recall, and F1-score, along with confusion matrix analysis.

The trained model was deployed using a Flask-based web dashboard that supports image upload, prediction history storage, disease database reference, and visualization analytics. Usability testing was conducted through questionnaire-based evaluation involving expert and normal users.

3 Results

The MobileNetV2 model achieved high classification accuracy and balanced precision-recall performance across disease classes. Confusion matrix analysis confirmed strong discrimination between healthy and diseased leaves. The deployed dashboard successfully delivered real-time predictions with low latency. User evaluation results indicated high usability scores. Participants reported that the interface was intuitive, easy to navigate, and informative. The inclusion of prediction history and disease reference features improved the system's practicality for agricultural decision-making.

4 Novelty of Project

This project addresses a research gap in AI-based Kenaf disease detection, a crop that has received limited attention compared to other agricultural plants. The novelty lies in combining a lightweight CNN architecture with a real-time dashboard system tailored for Kenaf crop monitoring. The integration of automated classification, disease knowledge base, and usability-focused interface makes the system suitable for field deployment and precision farming applications.

5 Conclusion or Future Work

The proposed Kenaf leaf disease detection system demonstrates that MobileNetV2 can deliver accurate and efficient classification while maintaining low computational requirements. The web-based dashboard enhances accessibility and usability for farmers and agricultural officers. Future work may include expanding the dataset, incorporating additional disease categories, deploying a mobile application version, and integrating IoT-based real-time crop monitoring to further support smart agriculture systems.

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DATA VISUALIZATION OF MALAYSIA'S FOREIGN WORKFORCE

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Abstract

The foreign workforce in Malaysia plays a crucial role in economic development, but fragmented data across multiple sources hinders informed decision-making. This research develops the Foreign Workforce Visualization Dashboard using the Waterfall model, consolidating DOSM data (2019-2024) through Python ETL processes, HIVE data warehouse, and Power BI visualizations. The dashboard achieved 100% functionality test success and 85% UAT score (39 respondents, TAM framework), demonstrating high usability and acceptance for workforce analysis and policy development.

Keywords: Data Visualization, Foreign Workforce, Dashboard, Power BI, Malaysia

1 Introduction

Malaysia's foreign workforce is essential for economic growth, particularly in manufacturing, construction, and services sectors. Most workers originate from Indonesia, Bangladesh, Nepal, Myanmar, and India. However, fragmented data across government agencies creates barriers for policymakers and businesses in workforce planning. This project addresses these challenges by developing a comprehensive visualization dashboard that consolidates DOSM data into an interactive platform, enabling multi-dimensional analysis across demographics, education and occupation.

2 Methodology

This study used the Waterfall Model guided development through six phases: Planning (defining objectives and scope), Analysis (literature review and DOSM data acquisition 20192024), Design (dashboard architecture and ERD), Build (ETL pipeline using Python/Excel, HIVE warehouse, Power BI visualizations via ODBC), Testing (16 functionality test cases and TAM-based UAT with 39 respondents), and Documentation. The dashboard was embedded in a Wix website for accessible web-based analytics.

3 Results / Findings

The findings of this study show that the dashboard features eight interactive pages: Overview (gender/nationality distribution), Heat Map (geographical visualization), Education, Certificate, Age, Occupation, Industry, and Trend Analysis. Functionality testing achieved 100% success across all 16 test cases. UAT results using TAM framework showed strong acceptance: Perceived Ease of Use (4.20), Perceived Usefulness (4.21), Attitude Toward Using (4.27), and Behavioural Intention to Use (4.26), with an overall mean of 4.235 validating the dashboard's usability and value for workforce analysis.

4 Novelty of Project / Product / Project

This project innovates by consolidating six years of comprehensive DOSM data into a unified platform with multi-dimensional interactive visualizations (heat maps, temporal trends, demographic breakdowns). The scalable ETL architecture (Python, HIVE, Power BI) processes large datasets efficiently. Web-based accessibility through Wix democratizes

workforce insights for diverse stakeholders. The TAM-based evaluation framework establishes a validated methodology for assessing visualization systems in Malaysia's public sector context.

5 Conclusion or Future Work

In general, the dashboard successfully consolidated DOSM data (2019-2024), created interactive visualizations, and achieved exceptional testing results (100% functionality, 84.7% UAT acceptance). Future enhancements include implementing real-time data integration via APIs with the Immigration Department and Ministry of Human Resources, incorporating 2025+ data, adding predictive analytics for trend forecasting, developing automated alert systems, expanding metrics to include wage data and regional comparisons, and creating mobile applications for field access. These improvements will transform the dashboard into a comprehensive decision-support system for evidence-based workforce policy development.

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UNVEILING THE TRANSFORMATION OF SONG ATTRIBUTES OVER TIME THROUGH AN INTERACTIVE DASHBOARD

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Abstract

The rapid growth of music streaming platforms has resulted in the availability of massive volumes of musical data, creating opportunities to analyze how song attributes evolve over time. This study presents the development of an interactive analytical dashboard that visualizes the transformation of song attributes across different time periods using Big Data technologies. The primary objective is to identify and analyze key musical attributes, including genre, tempo, energy, danceability, and emotional characteristics, based on a large-scale Spotify dataset collected over multiple years. The Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology was adopted to guide the project from data understanding to evaluation. Data preparation and transformation were performed using Big Data processing techniques, while Power BI was utilized to design an interactive dashboard that allows users to explore temporal trends and patterns in music attributes dynamically. Usability and functionality testing were conducted to evaluate the effectiveness of the dashboard in supporting music trend analysis. The results indicate that the dashboard successfully enhances users' ability to interpret changes in musical characteristics and identify long-term trends. This project demonstrates the potential of integrating Big Data analytics with interactive data visualization to provide valuable insights for music enthusiasts, researchers, and industry professionals.

Keywords: Big data analytics, music trends, interactive dashboard, data visualization, CRISP-DM

1 Introduction

The music industry has undergone significant transformation with the emergence of digital streaming platforms, which generate vast amounts of data related to song characteristics and listener behavior. Traditional methods of music analysis are often insufficient to handle the scale, complexity, and temporal nature of such data. As a result, there is a growing need for systematic approaches that combine Big Data analytics and interactive visualization to support meaningful exploration of music trends. Understanding how song attributes such as tempo, energy, genre, and emotion change over time can provide valuable insights into cultural shifts, audience preferences, and industry evolution. This study addresses these challenges by proposing an interactive dashboard that enables users to visually explore and analyze the transformation of song attributes over extended periods in an intuitive and data-driven manner.

2 Methodology

This study used the Cross-Industry Standard Process for Data Mining (CRISP-DM) as the guiding methodology due to its structured and iterative nature, which is suitable for Big Data analytics projects. The dataset was obtained from Spotify through a publicly available source and consisted of over 170,000 records with multiple song attributes. The methodology involved six main phases: business understanding, data understanding, data preparation, development, evaluation, and deployment. Data cleaning and transformation were carried out using Big Data processing techniques to ensure consistency and accuracy. The refined dataset was stored in a distributed environment and later integrated into Power BI for visualization. Interactive elements such as filters, slicers, and multiple chart types were incorporated to enable users to explore temporal patterns and relationships among music attributes effectively.

3 Results / Findings

The findings of this study show that the developed interactive dashboard effectively reveals meaningful patterns and trends in song attributes over time. Analysis results indicate noticeable changes in attributes such as tempo, energy, and danceability across different periods, reflecting evolving music styles and listener preferences. User evaluation through functionality and usability testing demonstrates that the dashboard is easy to use, visually clear, and effective in supporting music trend exploration. Users were able to identify correlations between musical attributes and time periods more efficiently compared to traditional static analysis methods. These results confirm that interactive visualization significantly enhances the understanding of complex music datasets and supports exploratory analysis for both technical and non-technical users.

4 Novelty of Project / Product / Project

This dashboard introduces a novel approach by integrating Big Data analytics with an interactive visualization platform to analyze the transformation of song attributes over time in a single, unified system. Unlike existing music analytics tools that focus on static summaries or short-term trends, this dashboard emphasizes long-term temporal analysis and user-driven exploration. The use of the CRISP-DM methodology ensures a systematic data mining process, while Power BI enables dynamic interaction with large datasets. The project's novelty lies in its ability to transform complex music data into intuitive visual insights that are accessible to music enthusiasts, researchers, and industry professionals without requiring advanced technical expertise.

5 Conclusion or Future Work

In general, the developed interactive dashboard successfully demonstrates how Big Data analytics and visualization techniques can be applied to analyze the evolution of song attributes over time. The project contributes a practical tool that enhances understanding of music trends and supports data-driven insights in the music domain. Future work may include integrating real-time streaming data, expanding the analysis to include listener behavior and sentiment analysis, and incorporating predictive analytics to forecast future music trends. These enhancements could further strengthen the dashboard's value as a comprehensive music analytics platform.

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BIG DATA DRIVEN SENTIMENT ANALYSIS AND VISUALIZATION OF BOOK REVIEW

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Abstract

Book reviews play a very important role for authors to analyse the trends of the most popular books by their readers. However, current approaches to sentiment analysis in book reviews rely on limited data sets and standard data-processing techniques, which are not sufficient to process large amounts of information. The aim of this research is to develop a data warehouse integrating book reviews with relevant analytical data, to design and implement a Power BI system for visualizing book reviews, and to assess its performance and usability through functional testing and user acceptance. The system has been built using Python for data processing, machine learning algorithms for categorizing sentiment, and Microsoft Power BI for interactive dashboard-graphs. A vast dataset of user-generated book reviews was collected and processed by means of an ETL pipeline, which included the preparation of the text. They learned how to classify reviews as positive, negative, or neutral. The findings have been visualised using dynamic dashboards that allow users to explore trends in sentiment over time and across genres. The evaluation included accuracy testing and comments from users on acceptance. Book publishers can use the system to obtain actionable information on the readers' perception. The system provides interested parties, such as authors, with actionable insights into the reader's experience. The results show that the combination of scalable big data technology with comprehensible visual tools improves our understanding of public opinion in literature.

Keywords: Book Review, Microsoft Power BI, Sentiment Analysis, data warehouse, Python

1 Introduction

The rapid growth of online platforms has led to an explosion of user-generated book ratings, which influence purchasing decisions, the reputation of authors and publishing strategies. However, the assessment of large-scale unstructured text data using standard approaches is difficult as it is often limited in its scalability and analytical capacity (Fan et al., 2014) . Sentiment analysis automatically detects opinions and emotional polarity in text, providing a greater understanding of public perception (Liu et al., 2024). This project presents a big data-driven sentiment analysis and visualization system combining data processing, machine learning classification and interactive dashboards. The aim is to transform unstructured book reviews into structured insights that can be used to inform literary decision-making in a data-driven way.

2 Methodology

The study used CRISPR-DM (Wirth & Hipp, n.d.) as a reference for its development. The project started with the definition of the goal of creating a scalable system for the analysis of large volumes of book reviews. The dataset of user-generated reviews was collected and processed by Python-based ETL pipeline. Text pre-processing techniques such as cleaning, tokenization and deletion of stop words were used to prepare the data for analysis. Machine learning techniques have been used to categorise reviews as positive, negative or neutral, enabling the recognition of opinions automatically (Liu et al., 2024). The processed data has been stored in a data warehouse in order to facilitate an effective analysis. Microsoft Power BI has been used to create interactive dashboards that visualize sentiment distribution, genre

matching, and trend-based trends. The evaluation of the system was performed by means of functional testing and user acceptance testing based on the technology acceptance model (TAM), which assesses perceived utility and ease of use.

3 Results / Findings

The method effectively converted unstructured book reviews into structured information about the reader's beliefs. The sentiment classification model performed well when determining the polarity of the reviews. Power BI dashboard allowed users to explore sentiment trends dynamically across genres and time periods. User acceptance testing has yielded positive results in terms of perceived utility and ease of use, which are in line with the principles of TAM. Users have acknowledged that the technology has helped them to explore the reader input more effectively. These findings show that the combination of big data processing and visual analytics improves our understanding of the reader's experience in literature.

4 Novelty of Project / Product / Project

The novelty of this project lies in the integration of the processing of large data, data storage, sentiment classification by machine learning and interactive visualisation into one framework. Unlike conventional studies which are focused only on sentiment prediction, this system offers a full analytical solution, from data mining to dashboard reporting. This integrated approach increases scalability and practical application in the real-world publishing environment.

5 Conclusion or Future Work

In conclusion, the system developed effectively converts extensive data from book reviews into meaningful and actionable insights. The combination of ETL processing, sentiment analysis, structured storage, and Power BI dashboard will allow stakeholders to evaluate feedback from readers more effectively. The evaluation results show that the system is very user-friendly and popular. Future improvements could include the use of advanced deep learning models to improve contextual understanding and the integration of real-time data updates for continuous sentiment tracking.

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FORECASTING AND ASSESSING THE ECONOMIC IMPACT OF FLOOD IN MALAYSIA BASED ON BIG DATA APPROACH

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Abstract

Floods are among the most frequent natural disasters in Malaysia and continue to cause significant economic losses across multiple sectors, including residential properties, infrastructure, agriculture, and business activities. Existing flood monitoring systems in Malaysia mainly focus on hydrological indicators such as rainfall intensity and river water levels, with limited emphasis on analysing or forecasting economic impacts. This study presents a big data driven web-based platform integrated with an interactive Power BI dashboard to analyse and forecast flood related economic losses in Malaysia. Historical flood loss data from 2021 to 2024 were obtained from the Department of Statistics Malaysia (DOSM). The project adopted a modified Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology. Data were cleaned, transformed, and normalised using Python, stored in a Hadoop Distributed File System (HDFS), and analysed using Apache Hive. The processed data were visualised through an interactive dashboard embedded within a website to support trend analysis and simple forecasting. User Acceptance Testing (UAT) involving 31 respondents indicated positive results in terms of perceived ease of use, perceived usefulness, attitude, and intention to use. An expert heuristic evaluation further confirmed that the system achieved satisfactory usability with minor improvements suggested. The proposed platform enhances understanding of flood related economic impacts and supports data driven disaster planning and resilience efforts in Malaysia.

Keywords: Flood forecasting, Economic impact, Big data analytics, Power BI dashboard, Disaster management

1 Introduction

Flooding is one of the most common and damaging natural disasters in Malaysia, particularly during the northeast monsoon season. Rapid urbanisation, inadequate drainage systems, deforestation, and climate change have intensified both the frequency and severity of flood events (Rosmadi et al., 2023). Recent major floods, including the December 2021 disaster, resulted in billions of ringgits in economic losses, affecting infrastructure, housing, agriculture, and businesses. Although Malaysia has several flood monitoring dashboards such as NDCC and Public Info Banjir, these systems primarily provide hydrological data and real time alerts. They lack integrated economic loss analysis and forecasting capabilities. This limitation restricts stakeholders' ability to evaluate long term financial impacts and plan proactive mitigation strategies. Therefore, there is a need for a data driven analytical platform that integrates historical economic loss data with interactive visualisation and predictive insights.

2 Methodology

This study adopted a modified CRISP-DM methodology consisting of business understanding, data understanding, data preparation, development, deployment, and evaluation phases (Ahmad et al., 2022). Historical flood economic loss data (2021–2024) were obtained from DOSM. Data preparation involved cleaning, transformation, and normalisation using Python in Jupyter Notebook. The processed datasets were stored in Hadoop Distributed File System (HDFS) and analysed using Apache Hive to perform structured queries and aggregation. An interactive dashboard was developed using Microsoft Power BI to visualise annual losses, sector wise breakdowns, state comparisons, and trend-based forecasts. The dashboard was embedded within a web-based platform to improve accessibility. System evaluation was

conducted using User Acceptance Testing (UAT) based on the Technology Acceptance Model (TAM), measuring perceived ease of use, perceived usefulness, attitude, and behavioural intention (Marnie Umirah et al., 2025). Additionally, heuristic evaluation was performed by experts using established usability principles.

3 Results / Findings

The findings of this study show that the dashboard successfully visualised historical flood related economic losses across Malaysian states and sectors. Analysis revealed that residential (living quarters) recorded the highest economic losses compared to other sectors. Comparative state analysis and annual trend visualisations enabled users to identify high risk regions and patterns over time. UAT results from 31 respondents indicated positive acceptance across all TAM dimensions, demonstrating that users perceived the system as useful and easy to use. The overall behavioural intention score suggests strong potential for continued usage. Heuristic evaluation findings showed that the dashboard adhered to key usability principles such as visibility of system status, consistency, and minimalist design. Minor refinements were suggested, particularly in navigation clarity and visual enhancements.

4 Novelty of Project / Product / Project

Unlike existing Malaysian flood dashboards that focus primarily on hydrological monitoring and emergency updates, this project integrates economic impact analysis, historical trend exploration, and simple forecasting within a single interactive platform. The integration of big data technologies (Hadoop and Hive) with Power BI visualisation enhances analytical capability and scalability. The system also improves public accessibility to economic impact data, supporting evidence-based disaster planning and resilience initiative.

5 Conclusion or Future Work

In general, this study demonstrates the effectiveness of integrating big data analytics and interactive dashboard visualisation to analyse and forecast flood related economic impacts in Malaysia. The developed platform provides meaningful insights for policymakers, researchers, and the public to better understand financial vulnerabilities associated with floods. Future enhancements may include incorporating additional real time datasets, implementing advanced machine learning forecasting models, expanding geographic data granularity, and increasing the sample size for system evaluation.

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Pathwise: A DATA-DRIVEN VISUALISATION OF EXPLORING GRADUATE DIRECTIONS TRENDS

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Abstract

The transition from academic life to employment or further studies remains a significant challenge for fresh graduates due to fragmented graduate outcome information and limited decision-support tools. Many graduates struggle to understand employability trends and identify suitable post-graduation pathways based on available data. This study presents Pathwise, a data-driven visualisation dashboard designed to assist graduates in exploring graduate direction trends through interactive and interpretable visual analytics. Graduate datasets covering multiple academic levels were processed using Extract, Transform, and Load (ETL) techniques and visualised using Power BI to present trends related to employment, further studies, and unemployment. In addition to visualisation, Pathwise incorporates a quiz-based supporting feature grounded in the RIASEC (Realistic, Investigative, Artistic, Social, Enterprising, and Conventional) theory to promote self-reflection on users' interests and personality traits. The system was evaluated through User Acceptance Testing (UAT) based on the Technology Acceptance Model (TAM). The evaluation results indicate high user acceptance, with mean scores of 4.22 for perceived ease of use, 4.25 for perceived usefulness, 4.28 for attitude towards using, and 4.30 for behavioural intention to use. These findings demonstrate that Pathwise effectively supports graduates in understanding graduate trends and enhances awareness in planning their future directions.

Keywords: Data visualisation, Employment, Graduate employability, Informed decision support, Power BI, RIASEC, Technology Acceptance Model, Unemployment

1 Introduction

Graduate employability has become an increasingly important concern in Malaysia as graduates face uncertainties when transitioning from higher education to the workforce or further studies. The lack of centralised and easily interpretable graduate outcome information often results in confusion and poor decision-making among graduates. While existing systems mainly provide static reports or summaries, they lack interactive elements that allow users to explore trends and gain meaningful insights. To address this issue, this study proposes Pathwise, a data-driven visualisation dashboard that enables graduates to explore graduate direction trends interactively. By integrating visual analytics with a supporting self-assessment feature, the system aims to improve graduates' awareness and understanding of their potential career or academic pathways.

2 Methodology

This study adopts the CRISP-DM methodology, focusing on data understanding, data preparation, system development, and evaluation. Graduate datasets from multiple academic levels were collected and processed using ETL techniques to ensure consistency and accuracy. (Shimaoka et al., 2024). The cleaned data were visualised using Power BI to present graduate direction trends through interactive dashboards. The Pathwise website was developed using Wix Studio, while a quiz-based supporting feature was created using Quizell. The quiz applies rule-based logic grounded in RIASEC theory to assess users' interests and personality traits. User Acceptance Testing was conducted using the Technology Acceptance Model to evaluate the usability and acceptance of the system.(Batista & Gondim, 2023)

3 Results / Findings

The developed Pathwise dashboard successfully visualises graduate employability and further study trends in an interactive manner, allowing users to explore data dynamically. The supporting quiz feature on the website encourages self-reflection by helping users identify their dominant RIASEC personality traits (Batista & Gondim, 2023). The UAT results indicate a high level of system acceptance, with all TAM constructs achieving mean scores above 4.20. These results demonstrate that users perceive the system as easy to use, useful, and relevant for supporting their decision-making process regarding post-graduation planning.

4 Novelty of Project / Product / Project

The novelty of this project lies in the development of an interactive, data-driven visualisation dashboard that enables graduates to explore graduate direction trends in a clear and interpretable manner. Pathwise allows users to interact with visual analytics for better understand graduate employability, employment insight and prediction patterns. In addition, the system incorporates a quiz-based feature grounded in RIASEC theory as a supporting additional component within the website. This quiz recommender serves as supplementary information to promote self-reflection and awareness among users.

5 Conclusion or Future Work

In conclusion, Pathwise demonstrates the effectiveness of data-driven visualisation in supporting graduates to explore graduate direction trends. For future work, the system may be enhanced by incorporating real-time updated data sources to ensure that graduate trend information remains current and relevant. Next, export functionalities could be introduced to allow users to download insights for reporting or academic reference. Lastly, mobile optimisation can be explored to improve accessibility enabling users to interact with the system more conveniently.

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STUDENT DISEASE PATTERN AT UITM CLINIC

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Abstract

University clinics collect large volumes of student medical records; however, these data are rarely analyzed systematically to support healthcare planning. This study aims to explore and visualize student disease patterns at the UiTM Clinic using big data analytics techniques. Historical clinic records containing anonymized information such as visit dates, diagnosed diseases, prescribed medication, gender, and demographic attributes were analyzed. The Cross-Industry Standard Process for Data Mining (CRISP-DM) framework was adopted to guide the analytical process, from business understanding to deployment. Data preprocessing was conducted using Python libraries including Pandas and NumPy, followed by structured querying through Apache Hive within a Hadoop ecosystem. The processed data were then visualized using Power BI to develop an interactive dashboard that presents disease frequency, seasonal trends, gender-based distribution, and semester-related spikes. A User Acceptance Test (UAT) was conducted to evaluate usability, clarity, and decision-support effectiveness. Results indicate that the dashboard enhances understanding of student health trends and supports proactive healthcare planning. The study demonstrates how integrating data mining methodology with interactive visualization tools can transform raw clinical data into actionable insights for improved resource allocation and preventive healthcare strategies in university settings.

Keywords: Big Data Analytics, CRISP-DM, Disease Pattern, Healthcare Visualization, Power BI

1 Introduction

University clinics collect extensive student medical records, yet these data are rarely analyzed systematically for strategic healthcare planning. Demand forecasting is essential in institutional healthcare settings to ensure efficient resource allocation and timely medication availability (Subramanian, 2021). Although big data analytics and predictive modelling have improved healthcare decision-making in many environments (Badawy et al., 2023), campus clinics often underutilize electronic health records for identifying disease trends. As a result, opportunities for proactive intervention and optimized planning remain limited. Therefore, this study analyzes student disease patterns at UiTM Clinic using big data analytics and interactive visualization to support evidence-based healthcare management.

2 Methodology

This study adapts the Cross-Industry Standard Process for Data Mining (CRISP-DM) framework to ensure a structured and systematic analytical approach (Schröer et al., 2021). Anonymized clinic records were preprocessed using Python libraries such as Pandas to address missing values and inconsistencies. To support scalable storage and structured querying, the dataset was managed using Hadoop Distributed File System (HDFS) and Apache Hive, reflecting modern big data practices in healthcare analytics (Khanra et al., 2020). Descriptive analysis was conducted to identify disease trends, and the findings were presented through an interactive Power BI dashboard to enhance interpretability and decision support.

3 Results / Findings

The developed dashboard successfully visualizes key student health trends, including the most frequently reported illnesses, seasonal fluctuations, and demographic-based disease

distribution. Interactive filtering allows stakeholders to analyze patterns by semester and gender, supporting targeted intervention strategies.UAT feedback indicates high user satisfaction regarding dashboard clarity and usefulness. Respondents reported improved understanding of disease patterns and perceived the system as beneficial for medicine inventory planning and preventive health campaigns. The findings demonstrate that structured data mining combined with interactive visualization enhances healthcare decision-making within university clinics.

4 Novelty of Project

This study presents a localized application of big data analytics within a Malaysian university clinic setting, transforming raw student health records into actionable insights through structured data mining and interactive visualization. By integrating the CRISP-DM framework with Hadoop-based storage and Power BI dashboards, the project moves beyond static reporting toward dynamic healthcare decision support. The approach demonstrates a scalable model for proactive campus healthcare planning and data-driven resource management.

5 Conclusion or Future Work

This study demonstrates that applying big data analytics and interactive visualization techniques can significantly enhance healthcare planning at UiTM Clinic. By identifying disease trends and demographic distributions, the system supports informed decision-making and proactive intervention strategies.

Future work may include integrating predictive modeling for disease forecasting, incorporating real-time data streams, and expanding the system across multiple UiTM campuses to strengthen institutional healthcare intelligence.

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DATA ANALYTICS AND VISUALIZATION FOR CRIME PATTERN DETECTION AND SOCIOECONOMIC CORRELATION IN INDIA

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Abstract

Crime in India exhibits complex spatial and temporal patterns closely associated with socioeconomic factors such as unemployment, literacy, poverty, and population distribution (Bandyopadhyay et al., 2021; Hazra, 2021). Prior studies show that integrating socioeconomic indicators with crime data enhances crime trend analysis and hotspot identification (Mishra, 2023), yet conventional analytical approaches struggle with large and heterogeneous datasets, limiting timely insights (Gandomi & Haider, 2020). This paper proposes a data analytics and visualization framework for crime pattern detection and socioeconomic correlation analysis in India. Large-scale crime and socioeconomic datasets are integrated using big data technologies, including Apache Hadoop, Apache Spark, and Apache Hive (Kumar et al., 2022). An Extra Trees Classifier is applied to predict crime risk levels, and results are presented through an interactive dashboard developed using Python and Streamlit. User Acceptance Testing (UAT) indicates that the framework effectively supports data-driven crime analysis and informed decision-making, demonstrating the value of combining big data analytics, machine learning, and visualization for evidence-based crime prevention.

Keywords: Crime analytics, Socioeconomic factors, Big data, Machine learning, Visualization

1 Introduction

Crime remains a major societal challenge in India and is influenced by multiple interconnected socioeconomic factors, including income inequality, unemployment, education level, and demographic structure (Bandyopadhyay et al., 2021; Tyagi, 2021). Crime rates vary significantly across regions and evolve as social and economic conditions change (Hazra, 2021). Traditional crime analysis methods struggle to process large volumes of data collected from multiple agencies, resulting in fragmented analysis and delayed insights (Gandomi & Haider, 2020). Recent advances in big data analytics and machine learning enable large-scale data integration, pattern discovery, and predictive analysis, supporting proactive crime prevention and evidence-based policymaking (Kumar et al., 2022).

2 Methodology

This study adopted a structured Waterfall methodology encompassing planning, design, development, testing, and evaluation. Crime data were obtained from public crime records, while socioeconomic data were sourced from national census and government datasets. An Extract, Transform, Load (ETL) process was used to clean and integrate the data. Apache Hadoop, Spark, and Hive supported scalable data storage and processing (Gandomi & Haider, 2020). An Extra Trees Classifier was applied to predict crime risk levels due to its robustness with high-dimensional data (Mishra, 2023), and results were visualized through an interactive dashboard developed using Python and Streamlit.

3 Results / Findings

The findings reveal significant relationships between crime rates and socioeconomic variables such as unemployment, literacy rate, poverty level, and population size, consistent with

previous studies in the Indian context (Bandyopadhyay et al., 2021; Hazra, 2021). The machine learning model demonstrated reliable performance in classifying crime risk levels and identifying high-risk regions. Feature importance analysis indicated that unemployment and population-related factors were among the strongest predictors of crime, supporting earlier empirical findings (Mishra, 2023). User Acceptance Testing results showed high levels of ease of use, perceived usefulness, and overall user satisfaction with the interactive dashboard.

4 Novelty of Project / Product / Project

The novelty of this project lies in the integration of big data technologies, machine learning-based crime prediction, and interactive visualization within a single analytical framework. Unlike conventional crime dashboards that focus mainly on descriptive analysis (Rai et al., 2022), the proposed system incorporates predictive analytics and explainable insights to support proactive and evidence-based crime prevention and policy planning.

5 Conclusion or Future Work

In conclusion, the proposed framework effectively integrates big data analytics, machine learning, and visualization for crime pattern detection and socioeconomic analysis. The system supports data-driven crime prevention and policy planning in India. Future work may incorporate real-time data, additional socioeconomic indicators, and advanced predictive models to improve accuracy and scalability (Kumar et al., 2022).

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DATA VISUALIZATION OF SLEEP ADVISER SYSTEM TO IMPROVE SLEEP QUALITY

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Abstract

Poor sleep quality is a global issue impacting physical and mental well-being, often influenced by mental health status, BMI, and lifestyle habits. This paper presents the development of a Sleep Adviser System that integrates interactive data visualization and machine learning techniques to help individuals improve their sleep quality. Using the CRISP-DM framework, the project analyzed a large-scale dataset of over 300,000 records from the Public Health and Sleep Lifestyle dataset. The system utilizes Big Data technologies, including HDFS and Apache Hive, for scalable data management. A Random Forest Classifier was trained to predict sleep quality based on lifestyle factors, achieving an accuracy of 60.42%. The findings reveal significant correlations between physical activity, mental health, and sleep efficiency. The system provides actionable insights through an interactive Streamlit web application and Power BI dashboards. User Acceptance Testing (UAT) results showed high scores in perceived ease of use (4.38), confirming the system's effectiveness as a lifestyle advisory tool.

Keywords: Sleep Quality, Data Visualization, Machine Learning, Random Forest, Big Data

1 Introduction

Quality sleep is fundamental to sharp cognitive function and optimum physical health for every individual yet sleep disturbance has become a serious global issue affecting overall mental and physical well-being (Alghwiri et al., 2021). In Malaysia, statistics show a worrying trend of increasing sleep problems among students and adults, which is often linked to pre-sleep smartphone usage habits and modern lifestyle stress (Jie et al., 2024; Esubalew et al., 2024). Previous research has also proven that biometric factors and daily activities, such as Body Mass Index (BMI), physical activity levels, and mental health stability, have a direct correlation with an individual's sleep efficiency (Zhang, 2023; Liao et al., 2025). Therefore, the development of a sleep advisory system based on Big Data analysis is highly necessary to provide deeper personalized insights and help users effectively improve their sleep patterns (Hamza et al., 2023).

2 Methodology

This project was implemented by adopting the Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology to ensure each phase of data analysis was conducted systematically and structurally. During the data collection phase, the study utilized a large-scale sleep lifestyle and health dataset containing over 300,000 records to guarantee analytical accuracy within a Big Data environment. In terms of data management, the system employs distributed storage technologies such as the Hadoop Distributed File System (HDFS) and Apache Hive via Docker environments for stable data processing and high scalability. For the development of the predictive model, the Random Forest Classifier algorithm was selected due to its superiority in handling complex and multi-dimensional variables. Subsequently, data visualization and user interfaces were developed using Power BI to produce interactive dashboards that allow users to easily understand their health trends. Finally, the effectiveness

of the system was evaluated through User Acceptance Testing (UAT) based on the Technology Acceptance Model (TAM) framework to measure user acceptance and usability.

3 Results / Findings

The findings of this study show that Random Forest model achieved a predictive accuracy of 60.42%. Data analysis indicated that female participants reported higher levels of mental health struggles associated with poor sleep. Furthermore, the visualization highlighted a direct correlation between increased age and longer sleep duration. The UAT results were highly positive, with a mean score of 4.38 for "Perceived Ease of Use," suggesting that the integration of complex data into a simple visual interface significantly aids user understanding.

4 Novelty of Project / Product / Project

The novelty of this project lies in the integration of a Big Data backend (HDFS/Hive) with a real-time predictive web application. Unlike static health trackers, this system provides a holistic view of sleep health by analyzing the intersection of mental health, BMI, and physical activity through an interactive, automated advisory platform.

5 Conclusion or Future Work

In general, the Sleep Adviser System successfully demonstrates how machine learning and data visualization can be used to promote better health habits. Future work will focus on integrating real-time data from wearable IoT devices and developing a mobile application to provide users with instant sleep quality notifications and localized health recommendations.

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WOOD SPECIES RECOGNITION SYSTEM USING IMAGE PROCESSING TECHNIQUES

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Abstract

Accurate wood species identification is essential for supporting sustainable forestry, biodiversity conservation, and timber trade regulation. Conventional identification methods rely on expert knowledge and manual inspection of anatomical features, which are time-consuming and prone to human error. This study presents a wood species recognition system using image processing and deep learning techniques. The system utilizes macroscopic wood surface images from the CITESWoodID dataset, which contains 1,901 images from 46 tropical wood species. Image pre-processing techniques, including resizing and normalization, were applied to standardize input data before model training. A lightweight Convolutional Neural Network (CNN), MobileNetV2, was implemented using transfer learning to improve classification performance while reducing computational complexity. The trained model was integrated into a Flask-based web application that enables real-time image upload and prediction. Model performance was evaluated using accuracy, precision, recall, and F1-score metrics, while usability testing involving expert and general users assessed system practicality. The results indicate that the proposed system achieves reliable classification performance and provides a user-friendly interface, demonstrating the potential of deep learning–based wood recognition systems for forestry and environmental applications.

Keywords: Wood Species Recognition, Image Processing, Deep Learning, MobileNetV2, CNN

1 Introduction

Wood species identification is crucial for sustainable forest management and timber trade regulation. In tropical regions, identification is challenging due to the similarity of anatomical structures among species (Cano Saenz et al., 2022). Conventional methods rely on expert-based examination, which is time-consuming and subjective (Ergun, 2024). Although laboratory techniques such as spectroscopy and DNA barcoding offer high accuracy, they require specialized equipment and controlled environments, limiting field use (Van Brusselen et al., 2023). Recent advances in artificial intelligence have enabled automated image-based classification using Convolutional Neural Networks (CNNs) (Liu et al., 2024). Therefore, this study develops a lightweight CNN-based wood species recognition system to provide a faster and more scalable identification solution.

2 Methodology

This study adopted a structured development methodology including dataset preparation, model development, and evaluation phases. The CITESWoodID dataset developed by (Souza et al., 2020), consisting of 1,901 macroscopic wood images from 46 tropical species, was utilized and divided into training, validation, and testing sets using stratified splitting. Image pre-processing techniques such as resizing to 224×224 pixels and normalization were applied to standardize input data. Data augmentation methods, including rotation, flipping, and zooming, were implemented to enhance robustness and reduce overfitting (Cano Saenz et al., 2022). MobileNetV2 was selected for its lightweight architecture, and transfer learning was applied by freezing base layers and fine-tuning selected layers (Ergun, 2024; Liu et al., 2024).

The trained model was integrated into a Flask-based web application to enable real-time image upload and prediction.

3 Results / Findings

The trained MobileNetV2 model demonstrated strong classification performance when evaluated using unseen test data, achieving high accuracy, precision, recall, and F1-score values. The developed web-based system provided real-time prediction results with species information and confidence scores. Usability evaluation involving expert and general users showed positive feedback on system usability, clarity of prediction output, and ease of interaction. The prediction history feature further improved system transparency and user experience.

4 Novelty of Project / Product / Project

The novelty of this project lies in integrating a lightweight deep learning model with a user-friendly web-based wood species recognition system. Unlike traditional identification methods that require laboratory equipment or expert knowledge, the proposed system enables automated classification using macroscopic images and standard computing devices. The use of transfer learning with MobileNetV2 improves classification efficiency with a limited dataset size. Additionally, the integration of prediction history and species metadata enhances system usability, making it suitable for educational, research, and forestry monitoring applications.

5 Conclusion or Future Work

In general, this study successfully developed a wood species recognition system using image processing and deep learning techniques. The MobileNetV2-based CNN demonstrated reliable classification performance, while the web-based application provided an accessible and user-friendly identification platform. Future work may focus on expanding dataset diversity, improving classification accuracy using advanced architectures, and deploying the system to mobile platforms for field applications. Integration with cloud-based AI services may further enhance scalability and support real-time forestry monitoring.

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ONLINE SHOPPING TRENDS & CONSUMER SENTIMENT ANALYSIS USING BIG DATA ANALYTICS

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Abstract

The rapid growth of e-commerce platforms has led to an increasing volume of online customer reviews, making it challenging for consumers and businesses to extract meaningful insights from unstructured textual data. Customer reviews contain valuable information regarding user experiences, satisfaction, and opinions about products and services. However, traditional analysis methods are often insufficient to process large-scale review datasets effectively. Therefore, this study aims to analyse online shopping trends and consumer sentiment using big data analytics and sentiment analysis techniques through an interactive dashboard called *ShopSense*. Customer review data were obtained from Amazon datasets available on Kaggle and processed using Apache Hive in a Hadoop-based environment. Natural Language Processing (NLP) techniques were applied to clean and classify the review texts into positive, neutral, and negative sentiments. The processed data were then visualized using an interactive Power BI dashboard and deployed through a supporting website developed using Wix. The system was evaluated using a User Acceptance Test (UAT) involving 30 respondents, focusing on perceived ease of use, perceived usefulness, attitude, and behavioural intention. The results indicate strong user acceptance, with all dimensions achieving mean scores above 4.0 on a 5-point Likert scale. Overall, the findings demonstrate that the ShopSense dashboard effectively supports the analysis of consumer sentiment and online shopping trends, providing meaningful insights to assist data-driven decision-making in the e-commerce domain.

Keywords: Sentiment Analysis, Big Data Analytics, Power BI, Interactive Dashboard, E-Commerce

1 Introduction

Online shopping has become an essential part of modern consumer behaviour, resulting in a large volume of customer reviews being generated daily. These reviews contain valuable information about customer satisfaction, product performance, and market trends, and they significantly influence consumers' purchasing decisions (Zhang & Shi, 2022). However, due to the unstructured nature and large scale of textual data, it is difficult for users and businesses to analyse and interpret this information effectively using traditional methods (Wu et al., 2025). This project addresses this challenge by developing an interactive dashboard named ShopSense to visualise online shopping trends and consumer sentiment. By applying big data analytics and sentiment analysis techniques, the system transforms raw customer review data into meaningful visual insights. The objectives of this study are to analyse customer reviews using Natural Language Processing (NLP), develop an interactive dashboard for visualisation, and evaluate user acceptance through User Acceptance Testing (UAT). The system aims to support better understanding of consumer behaviour and promote data-driven decision-making in the e-commerce domain (Yuan et al., 2024).

2 Methodology

This study adopts the Waterfall Model as the system development methodology, consisting of five phases: planning, design, development, testing, and evaluation. Customer review data were obtained from Amazon datasets available on Kaggle and processed using Apache Hive in a Hadoop environment. Data preprocessing and cleaning were performed using Python, followed by sentiment classification using Natural Language Processing (NLP) techniques to categorize reviews into positive, neutral, and negative sentiments. The processed data were visualized

using an interactive Power BI dashboard and deployed through a supporting website developed using Wix. Finally, a User Acceptance Test (UAT) involving 30 respondents was conducted to evaluate the system based on perceived ease of use, perceived usefulness, attitude, and behavioural intention.

3 Results / Findings

The developed ShopSense dashboard successfully visualizes online shopping trends and consumer sentiment through various interactive charts and filters. Users are able to explore review distributions across countries, product categories, and time periods, as well as analyse sentiment patterns and average ratings.The results from the User Acceptance Test indicate high levels of user satisfaction. All four evaluation dimensions achieved mean scores above 4.0, reflecting positive perceptions of usability, usefulness, and overall system acceptance. Participants reported that the dashboard is easy to use, visually appealing, and helpful for understanding consumer behaviour. These findings demonstrate that the ShopSense dashboard effectively transforms large volumes of unstructured review data into clear and actionable insights for user.

4 Novelty of Project / Product / Project

The novelty of this project lies in the integration of big data analytics, sentiment analysis, and interactive visualization within a single decision-support platform for e-commerce analysis. Unlike traditional static reports, the ShopSense dashboard provides a dynamic and user-friendly interface that enables users to explore consumer sentiment and online shopping trends interactively. The use of Apache Hive for managing large-scale datasets and Power BI for visualization highlights the practical application of business intelligence tools in supporting data-driven decision-making.

5 Conclusion or Future Work

The ShopSense interactive dashboard successfully achieves its objectives by providing meaningful visual insights into online shopping trends and consumer sentiment. The system demonstrates strong user acceptance and proves to be an effective tool for analysing large-scale customer review data.For future work, the system can be enhanced by integrating real-time data sources and predictive analytics to improve trend forecasting and support more advanced decision-making in e-commerce environments.

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INTERACTIVE DASHBOARD FOR PREDICTING AND VISUALIZING THE IMPACT OF STUDENT BEHAVIOUR ON ACADEMIC PERFORMANCE

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Abstract

Early identification of students at risk of academic underperformance is essential for improving learning outcomes and supporting timely intervention. This study develops an interactive Student Performance Analytics Dashboard that integrates predictive modeling and data visualization to forecast academic performance using behavioral indicators such as study hours, attendance, and previous scores. A Decision Tree Regression model was implemented using an 80:20 train-test split and evaluated using Mean Absolute Error (MAE) and R^2 score, achieving an MAE of 2.93 and an R^2 of 0.96. The predictive model was integrated into a web-based dashboard featuring performance summaries, behavioral insights, and simulation tools. User Acceptance Testing (UAT) with 44 respondents indicated high levels of perceived ease of use and usefulness. The findings confirm that integrating predictive analytics with interactive visualization enhances academic monitoring and data-driven decision-making.

Keywords: Educational Data Mining, Student Performance Prediction, Decision Tree Regression, Predictive Analytics, Dashboard Visualization

1 Introduction

Student academic performance is influenced by multiple behavioural and academic factors, including study habits, attendance patterns, and prior academic achievement. Recent studies in educational data mining highlight the importance of predictive analytics in identifying students at risk of underperformance and supporting early intervention strategies (Sharma & Singh, 2022). Educational institutions increasingly adopt intelligent systems to enhance academic monitoring and data-driven decision-making through learning analytics techniques (Kumar & Bhatia, 2023). However, many existing systems either focus primarily on visualization without predictive capabilities or implement predictive models without interactive analytical dashboards, limiting their practical usability. Therefore, this study aims to develop an interactive dashboard that integrates predictive analytics and visualization to provide meaningful academic insights and support proactive academic decision-making.

2 Methodology

This study adopts the Waterfall Model to ensure a structured development process with clearly defined phases (Alshamrani & Bahattab, 2021). The methodology includes preliminary study, analysis, design, development, and testing. Educational datasets were collected and pre-processed through cleaning, transformation, and encoding techniques. A Decision Tree Regression model was developed using an 80:20 train-test split due to its interpretability and effectiveness in educational data mining (Kumar & Bhatia, 2023). The model was integrated into a Flask-based interactive dashboard and evaluated using Mean Absolute Error (MAE), R^2 score, and User Acceptance Testing (UAT).

3 Results / Findings

The findings indicate that the Decision Tree Regression model achieved strong predictive performance, with an MAE of 2.93 and an R^2 score of 0.96 using an 80:20 train-test split. Correlation analysis identified previous academic scores and study hours as the strongest predictors of performance. The interactive dashboard effectively visualizes predictions and behavioral insights through dynamic charts and simulation features. User Acceptance Testing (UAT) with 44 respondents showed high usability and usefulness ratings, with mean scores above 4.30 out of 5.00. Overall, the system supports effective academic monitoring and data-driven decision-making.

4 Novelty of Project / Product / Project

This project presents an interactive academic analytics dashboard that integrates interpretable machine learning with visual data exploration in a unified platform. Unlike traditional reporting systems, it combines predictive modeling, behavioral analysis, and interactive visualization to deliver actionable insights for students and educators. The use of Decision Tree Regression enhances transparency by showing how behavioral factors influence predicted outcomes. A prediction simulation feature further supports proactive academic improvement by allowing users to adjust inputs and observe changes in performance.

5 Conclusion or Future Work

In general, the developed dashboard demonstrates that integrating predictive analytics with interactive visualization enhances student performance monitoring. The system provides accurate predictions, meaningful behavioral insights, and a user-friendly interface to support informed academic decisions. Future improvements may include real-time data integration, implementation of ensemble learning models to improve predictive accuracy, and personalized recommendation features to strengthen its applicability in real educational environments.

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DATA VISUALIZATION OF JOB MARKET TREND AND COST OF LIVING BY CITIES

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Abstract

WorkSight is a web-based job market and cost-of-living visualisation dashboard developed to support students, job seekers, and early-career individuals in making informed career and relocation decisions. Existing job platforms often focus on job listings without providing meaningful comparisons between salary levels and living costs across different cities, making it difficult for users to assess the real value of employment opportunities. This study aims to design and develop an interactive dashboard that integrates job market data with cost-of-living indicators to enhance decision-making clarity. The Waterfall development methodology was adopted, covering requirement analysis, system design, data preparation, dashboard development, and evaluation. Publicly available datasets related to job opportunities, salaries, required skills, and cost-of-living indices across more than 500 cities were processed using a Python-based Extract, Transform, and Load (ETL) approach and visualised using Microsoft Power BI. User Acceptance Testing (UAT) involving 30 participants indicated positive user acceptance, with high perceived ease of use and perceived usefulness. Overall, WorkSight demonstrates the potential of data visualisation dashboards in supporting data-driven career planning and location-based decision-making.

Keywords: Job market analysis, Cost of living, Data visualization, Dashboard, User Acceptance Testing (UAT)

1 Introduction

In today's rapidly changing employment landscape, understanding job market trends and cost-of-living differences across cities has become increasingly important. Job seekers often rely on online job postings; however, many lack access to data-driven tools that provide meaningful insights into employment opportunities and living affordability. Studies show that analyzing online job advertisements is an effective way to examine labour market trends and identify in-demand skills across regions (Cedefop, 2024). Advances in big data analytics have expanded job market analysis beyond traditional sources. Job opportunities are now advertised across digital platforms such as company websites, online recruitment portals, professional networking sites like LinkedIn, and gig economy platforms including Upwork and Uber, offering richer and more timely labour market insights (Vankevich & Kalinouskaya, 2021). At the same time, geographical location plays a crucial role in economic well-being, as higher wages in major cities are often offset by significantly higher living costs. Workers are frequently willing to trade part of their income for better living conditions, highlighting the need to evaluate salaries in relation to local cost-of-living factors (Diamond & Moretti, 2021). Therefore, this project introduces WorkSight, a job market and cost-of-living visualisation dashboard that integrates employment data with affordability indicators. By presenting job availability, salary levels, required skills, and living costs through interactive visualisations, WorkSight aims to support students, job seekers, and early-career individuals in making informed career *and r*elocation decisions.

2 Methodology

This study adopted the **Waterfall development methodology**, which consists of sequential phases including requirement analysis, design, development, testing, and evaluation. During the requirement analysis phase, relevant datasets and system requirements were identified

through literature review and data exploration. Public datasets were collected from sources such as Kaggle and other open data platforms. In the development phase, data cleaning, transformation, and integration were performed using Python through an Extract, Transform, and Load (ETL) process. The processed data was then visualised using Microsoft Power BI to create interactive dashboards featuring charts, maps, and filtering options. A simple web interface was developed using Wix to host and present the dashboard. System evaluation was conducted through manual functional testing followed by User Acceptance Testing (UAT) to assess usability and acceptance from the users' perspective.

3 Results / Findings

The evaluation results indicate that the WorkSight dashboard was positively received by users. Based on UAT analysis guided by the Technology Acceptance Model (TAM), respondents reported high levels of perceived ease of use and perceived usefulness. Users found the dashboard easy to navigate and effective in comparing job opportunities, salary levels, and cost-of-living conditions across cities. These findings demonstrate that WorkSight functions effectively as a decision-support tool for career and relocation planning.

4 Novelty of Project / Product / Project

The novelty of WorkSight lies in its integrated visualisation of job market trends and cost-of-living data within a single interactive dashboard. Unlike conventional job platforms that focus primarily on job listings, WorkSight emphasises comparative visual analytics to support affordability assessment and location-based decision-making. The dashboard provides users with a holistic view of employment opportunities by linking salaries, skills demand and living costs in an intuitive and user-friendly manner.

5 Conclusion or Future Work

In conclusion, WorkSight successfully demonstrates how an interactive data visualisation dashboard can support informed career and relocation decisions. The system enhances clarity and usability by transforming complex job market and cost-of-living data into accessible visual insights. Future work may include incorporating real-time data updates, expanding predictive analytics for job trends, and extending the dashboard to support additional user groups such as policymakers and employers.

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VISUALIZING THE CORRELATION BETWEEN STRESS LEVEL AND LIFESTYLE HABITS AMONG EMPLOYEES

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Abstract

Employee stress is an important issue in modern workplaces because prolonged stress can negatively affect individual well-being, job satisfaction, productivity, and overall organisational performance. High stress levels may also contribute to burnout, reduced work quality, and decreased employee engagement. However, analysing stress-related data can be challenging when it is presented in a non-visual and unstructured format, making it difficult to identify patterns and meaningful insights. Therefore, this study aims to develop Stresslytics, an interactive dashboard designed to visualise and analyse the relationship between employee stress levels and lifestyle habits in a clear and organised manner. The dashboard was developed using the Waterfall methodology, which includes requirement analysis, system design, development, testing, and evaluation to ensure a structured implementation process. Microsoft Power BI was used to design interactive features such as charts, filters, and summary views to support efficient and user-friendly data exploration. The dashboard was evaluated using the Technology Acceptance Model (TAM) through an online questionnaire to measure perceived usefulness and ease of use. The findings indicate positive user acceptance. Overall, Stresslytics serves as an effective analytical tool to support better understanding of employee stress through structured data visualisation and informed decision-making.

Keywords: Employee Stress, Data Visualisation, Interactive Dashboard, Lifestyle Habits, Technology Acceptance Model (TAM)

1 Introduction

Workplace stress is widely recognised as an important issue in modern organisations, as ongoing pressure can affect employees' mental health, reduce productivity, and influence overall organisational performance. Studies show that high levels of workplace stress are linked to anxiety, depression, lower job satisfaction, and reduced efficiency (Shanmugapriya et al., 2025). If not properly managed, long-term stress may also lead to burnout, absenteeism, and various health problems, which can further impact organisational outcomes. Lifestyle habits such as sleep duration, physical activity, eating patterns, and substance use are closely related to stress levels. Unhealthy routines, long working hours, and poor work-life balance may increase stress and make it harder for employees to maintain good physical and mental well-being (Ogundipe & Obeng-Gyasi, 2025; Park et al., 2020). Although stress-related data is available, many organisations still rely on static reports or spreadsheets. These traditional approaches make it difficult to explore multiple variables at once and to identify clear relationships between stress and lifestyle factors, limiting effective data-driven decisions. Therefore, this project introduces Stresslytics, an interactive stress-lifestyle visualization dashboard developed to analyse the relationship between employee stress levels and lifestyle habits. The objectives are: (i) to identify suitable techniques for visualising stress–lifestyle relationships, (ii) to design and develop the dashboard using data analysis and visualisation tools, and (iii) to evaluate its usability and functionality using the Technology Acceptance Model (TAM). The dashboard provides interactive insights to support better understanding of stress patterns, assist decision-making, and encourage healthier workplace practices.

2 Methodology

This study applied the Waterfall Model to guide the development process through requirement analysis, design, development, testing, and evaluation. The stress and lifestyle dataset was cleaned and prepared using Python before being implemented in Microsoft Power BI. The dashboard visualises employee stress levels and related lifestyle factors such as sleep, physical activity, diet, and working hours using interactive features to support data exploration. The system was evaluated using the Technology Acceptance Model (TAM) through a questionnaire distributed via Google Forms to assess usability and user acceptance.

3 Results / Findings

The evaluation results show that the dashboard was highly accepted by users. Based on the Technology Acceptance Model (TAM), all dimensions recorded mean scores above 4.50 on a five-point Likert scale. Users agreed that the visualisations improved their understanding of the relationship between stress and lifestyle habits, confirming the dashboard's effectiveness as an analytical tool.

4 Novelty of Project / Product / Project

The novelty of Stresslytics lies in its development of an interactive dashboard that visualises the relationship between employee stress levels and lifestyle habits. Unlike traditional static reports or spreadsheets, the dashboard presents multiple lifestyle variables in a single visual platform, allowing users to explore patterns and correlations more clearly. This approach makes stress-related data easier to interpret and supports better understanding of workplace well-being.

5 Conclusion or Future Work

In conclusion, Stresslytics demonstrates how an interactive dashboard can improve the analysis of employee stress and lifestyle habits. The system enhances clarity and usability by transforming complex stress data into clear visual insights that support better understanding of workplace well-being. Future work may include integrating real-time data, adding more lifestyle-related variables, and incorporating predictive analysis features to further strengthen the dashboard's analytical capability.

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UNBOXING STUDENT LIFE: A DATA-DRIVEN ANALYSIS OF LIFESTYLE HABITS AND ACADEMIC IMPACT

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Abstract

Lifestyle behaviours of university students, such as the quality of sleep, physical activities, and study patterns, have been found to be related to academic performance, but the relationship between these variables has not been well comprehended. It has been shown that healthy behaviours like sufficient sleep and balanced behaviour have positive relations with academic performance in a student population (Faught et al., 2017; Wang et al., 2025). Also, learning technology, such as learning analytics dashboards, offers practical information about learning behaviour patterns (Susnjak et al., 2022). In this study, secondary data based on Kaggle is used to examine the indicators of lifestyle and academic performance. The techniques used were descriptive and correlation analysis, which were used to extract behavioural patterns, and a dashboard was created to represent the important relationships. Findings indicate that adequate rest and planned behaviour have positive correlations with academic results, whereas lifestyle pressure factors exhibit the possibility of negative effects. The dashboard assists in making sense of data on complex behaviour and promotes evidence-based awareness. The results highlight the necessity of combining analytics and behaviour data to promote academic planning and student support.

Keywords:lifestyle behaviour, academic performance, learning analytics dashboard, Kaggle dataset, visual analytics.

1 Introduction

The academic success of students is determined by their lifestyle behaviours. Past studies indicate that a balanced diet, sleep, and exercise are associated with cognitive and academic performance in the younger population (Yadav, 2022; Faught et al., 2017). Academic performance is also associated with sleep quality and stress in college students (Wang et al., 2025). In the meantime, a learning analytics dashboard is a new trend that simplifies the access and utility of complex learner data to stakeholders (Susnjak et al., 2022). Nevertheless, not many studies have combined both the perspectives of lifestyle and analytics in a single framework to comprehend student behaviour. This project addresses such a gap by evaluating a Kaggle dataset to find the relationship between lifestyle indicators and academic performance and providing the results via a visual analytics dashboard.

2 Methodology

This paper has followed the CRISP-DM model of data analytics, with the first step being the acquisition of a structured Kaggle dataset with the variables of student behaviour and academic results. The data were pre-processed, and the data were cleaned before analysis. The distribution of lifestyle behaviour was summarised using descriptive statistics and correlation techniques investigated relationships between variables. Data exploration and modelling were assisted by the help of analytic tools like Python and Orange3. The findings were coded to an interactive visualisation dashboard. The theoretical perspective of learning analytics and its contribution to the process of self-regulation and academic planning in learners was also used in the study (Susnjak et al., 2022).

3 Results / Findings

The results indicate that high levels of sleep and structured behaviour have a positive correlation with better academic performance, which is supported by the studies claiming that lifestyle patterns are the predictors of academic success (Faught et al., 2017; Wang et al., 2025). Correlation visualisation revealed behavioural patterns that can be used to identify academic risk early. The dashboard has enabled multi-dimensional comparisons, which have shown how lifestyle factor combinations are connected to the performance outcomes. These findings support the importance of analytics to students and teachers.

4 Novelty of Project / Product / Project

The project is an interactive visualisation of secondary data analytics combined to find lifestyle-academic relationships previously unexplored using publicly available data. Using descriptive analytics and dashboard design, this paper will go beyond the basic reporting and allow one to discover patterns in student behaviour through exploration. This is an improvement in accessibility by users who do not have sophisticated technical skills.

5 Conclusion or Future Work

This study illustrates how a data-driven method is useful in assessing the relationship between lifestyle behaviour and academic performance. The graphics analytics dashboard offers practical information to the students and other stakeholders in education to ensure they are aware of the lifestyle determinants of success. Additional features in the future may involve predictive models and custom-made recommendations, and widening integrations with actual institutional systems to enable real-time monitoring.

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INTERACTIVE DASHBOARD TO ANALYZE THE EFFECTIVENESS OF SOCIAL MEDIA ADVERTISEMENT (ADS)

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Abstract

Literature Review Previous studies show that businesses should make use of social media advertising to complement word-of-mouth, connect with customers, and showcase their products on platforms like Facebook, Instagram, Twitter, and Pinterest. However, each platform stores the ad data separately, making comparison difficult and time-consuming to operate. This paper, therefore, introduces an interactive dashboard aimed at integrating all advertising data into one unified system. This project aims at displaying a few key metrics such as impression, click, engagement, CTR, Conversion Rate, CPC, and ROI by means of interactive visualizations. The dashboard was tested by using the User Acceptance Testing. Historical advertising data from Kaggle was analyzed using the CRISP-DM methodology. The technology stack consisted of Microsoft Excel, Python, Apache Hive, and Power BI. Testing of the dashboard was carried out among 30 respondents who said it was easy to use and that it would be effective in comparing the performance across various social media platforms using Google Forms. This study now concludes and presents a practical, inexpensive solution for social media advertising analysis, particularly for small business owners and digital marketers.
Keywords: Social Media Advertising, Literature Review, Interactive Dashboard, CRISP-DM

1 Introduction

Social media is widely used for businesses to advertise and reach their audience. Through social media like Facebook, Instagram, Twitter, and TikTok, businesses can reach a massive audience in anytime (Vitalis et al., 2023). But, as these businesses and companies upload their advertisements on the social media, this advertisement data was presented on all these platforms, and it becomes difficult and time-consuming to analyze these data. Analyzing all this becomes difficult. Hence, interactive dashboards are created, and all the key elements were presented in one format in the form of a chart and a graph. Most businesses and digital marketer had to face problems in analyzing ads related data due to a lack of proper means and tools. Moreover, businesses also spend more money on these ads placements without knowing which ads platform may prove to be more effective. This project aims to fill this void by creating an interactive dashboard for ads related data placed on social media. Through this interactive dashboard, businesses and digital marketers can know about the popularity of their advertisements and reduce spending.

2 Methodology

This study used the CRISP-DM methodology, was carried out in six steps understanding the business, understanding the data, data cleaning and preparation, models building, results evaluation, and finally deploying the system to users (Plotnikova et al., 2022). The project started with obtaining historical data on social media advertisements from Facebook, Instagram, Twitter, and Pinterest; then we dived deeper into the data to uncover profound insights. Data cleaning and preparation were carried out using Microsoft Excel and Python's Jupyter Notebook environment; then data storage occurred (Lathifah et al., 2023). Power BI was used to develop an interactive dashboard that visualizes key advertising metrics. To ensure usability and effectiveness, User Acceptance Testing (UAT) was conducted with 30 users. The

development process followed a structured approach to create a user-friendly tool for digital marketers and businesses.

3 Results/Findings

The findings of this study show that the usability tests carried out by the UAT on 30 respondents gave positive feedback on the interactive dashboard for its utility, ease of use, and effectiveness in analyzing social media advertisements. The respondents rated the interactive dashboard for its utility at 4.52, ease of use for 4.68, attitude for 4.76, and intention to use for 4.61 on a 5-point scale. Respondents were able to explain that the interactive dashboard was clear and helpful in getting a general idea of the metrics such as clicks and CTR. The respondents even came up with a few suggestions for the interactive dashboard for its use in the future, such as the incorporation of a time range feature and making the colours clearer for users who were colour blind.

4 Novelty of Project / Product / Project

The novelty of this project being designed to aggregate ad information from a variety of social media sites and bring them all together into one system. Rather than having to retrieve all these statistics from each individual platform separately, as they previously had to do, this new dashboard will give us the key statistics right next to each other. So, users can see impressions, clicks, CTR, conversions, CPC, and ROI all in the same place. It is very intuitive and easy to use, with visual representations that help us compare each platform's performance and monitor our campaigns. This was a very affordable option that was designed for small businesses and individual marketers who can't necessarily afford all the other complex analytics out there.

5 Conclusion or Future Work

The interactive dashboard successfully met its objectives by providing an easy-to-use interface for analyzing social media advertisement performance. Simple charts and filters helped users understand key metrics such as impressions, clicks, engagement, and conversions. User Acceptance Testing showed positive feedback from digital marketers, who found the dashboard useful and easy to use. However, the dashboard does not support real-time public data and does not include predictive analysis. In the future, the system can be improved by adding real-time data, including predictive features, expanding the testing group, and developing a mobile version to improve accessibility.

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BIG DATA-DRIVEN SENTIMENT ANALYSIS INSIGHTS TO SUPPORT RESTOCKING AND SALES STRATEGY DECISIONS IN WOMEN'S CLOTHING E-COMMERCE

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Abstract

E-commerce platforms for women's apparel have grown rapidly, producing vast amounts of unstructured customer feedback. As a result, manual analysis is not feasible for making wise decisions about restocking and sales tactics. This project suggests a big data-driven sentiment analysis system that helps sellers make data-driven decisions by gleaning actionable insights from online customer reviews. To facilitate scalable data storage, customer reviews were pre-processed using Apache Spark for large-scale processing and stored in the Hadoop Distributed File System (HDFS) from a publicly accessible Kaggle dataset. While Aspect-Based Sentiment Analysis (ABSA) was used to find consumer opinions on important product aspects like fit, comfort, and fabric quality, Support Vector Machine (SVM) was used to classify sentiment overall. An interactive Power BI dashboard was used to visualize the analysed results, which helped sellers comprehend trends in customer sentiment and product performance. To assess the system, User Acceptance Tests (UAT) and model performance metrics were employed. According to the results, the suggested system consistently performs well in sentiment classification and receives positive user feedback regarding its usability and usefulness. Overall, the system works well to assist women's clothing e-commerce decision-making regarding restocking and sales strategy.

Keywords: Big Data, Sentiment Analysis, Aspect-Based Sentiment Analysis, Women's Clothing E-Commerce, Power BI

1 Introduction

In e-commerce for women's clothing, customer reviews play an important role in influencing purchasing decisions, as customers often rely on feedback on sizing accuracy, comfort, and quality of products. However, the increasing number of online reviews is making it increasingly difficult for retailers to assess customer feedback manually and to identify meaningful patterns. These limitations may lead to poor inventory planning and ineffective sales strategy decisions. Sentiment analysis is a viable solution as it allows for the automatic interpretation of customer views and supports informed decision-making in online retail environments (Zainal et al., 2023).

2 Methodology

The methodology used in this study is the CRISP-DM (Cross-Industry Standard Process for Data Mining) framework, which ensures that the suggested system is developed and assessed in a methodical manner. Data from a dataset of over 23,000 reviews of women's clothing served as the main source (Kumar, 2020). To effectively preprocess and clean the vast amount of unstructured textual data, big data processing techniques were applied. Support Vector Machines (SVM) were used for overall sentiment classification, while Aspect-Based Sentiment Analysis (ABSA) was used to determine sentiment related to product attributes like fit, comfort, and fabric. Using the Power BI dashboard's tools, the processing results were made interactive so that users could examine and analyse the data. The application of this strategy is consistent with recognised data science practices in supporting data-driven decision-making (Provost & Fawcett, 2013).

3 Results / Findings

According to the results of the sentiment analysis, the provided system can identify sentiment patterns in customer reviews that are both general and aspect-based. When it comes to classifying reviews into positive, negative, and neutral categories, the SVM model consistently performs well. According to aspect-level analysis, fit and comfort are the most talked-about aspects of products, and low customer satisfaction is probably linked to negative sentiment in these areas. Sellers can determine which products need to be restocked, enhanced, or discontinued thanks to the interactive dashboard's effective visualization of sentiment trends and product performance. These findings support the significance of sentiment-based analysis in enhancing decision-making regarding purchases (Fan et al., 2018).

4 Novelty of the Project

This research is novel in that it combines sentiment analysis based on machine learning, big data processing, and aspect-level analysis into a single interactive decision-support system for e-commerce of women's apparel. Unlike the conventional approach, which uses only numerical ratings as its main analytical tool, this system examines unstructured text reviews to gather more detailed data about consumer sentiment. The project combines user-friendly visualization with scaled data processing to advance the field's understanding of women's clothing reviews and provide a helpful tool for assisting with restocking and sales strategy decisions.

5 Conclusion or Future Work

This research shows that a sentiment analysis system based on large data can effectively support the decision-making on restocking and sales strategies in e-commerce for women's clothing. The system increases the effectiveness of inventory planning and decision making by turning unstructured customer reviews into actionable insights. In the future, the system may be further developed by adding real-time review analysis, more sophisticated deep learning models and predictive analytics to increase the efficiency and value of the system for enterprises.

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INTERACTIVE DASHBOARD FOR MONITORING STUDENT MENTAL HEALTH

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Abstract

Mental health issues among university students are increasing due to academic pressure, financial stress, and lifestyle challenges, which can negatively affect academic performance and overall well-being. The project aims to develop an easy-to-use interactive dashboard to monitor and visualise student mental health data. This is because many students are not aware of their mental health condition early on, and universities often lack useful tools to monitor and understand students' well-being. The dashboard uses structured information such as financial stress, sleep quality, and lifestyle factors. Data understanding, preparation, and visualisation are the components of the CRISP-DM methodology used to guide this project. Python was used to clean and prepare the data, while Power BI was used to create interactive charts and graphs for better understanding. To find out how easy and useful the dashboard is, a User Acceptance Test (UAT) has been run. The result shows a high level of user satisfaction and increased understanding of the mental health trends of students. According to earlier research, interactive dashboards can be a useful tool for efficiently tracking and evaluating students' mental health. This project demonstrates how visualisation tools can help institutions monitor students' well-being and promote early awareness.

Keywords: Student Mental Health, Interactive Dashboard, Data Visualisation, Depression, Student Well-being

1 Introduction

University students are experiencing more mental health issues as a result of lifestyle difficulties, financial stress, and academic pressure, all of which can have an impact on daily life and academic performance (Campbell et al., 2021). However, mental health awareness remains low, and many universities do not have adequate systems in place to monitor students' mental health. The overall mental health state of students is often not well represented by current methods, such as brief surveys or counselling (Yoo & De Choudhury, 2019). Therefore, the goal of the project is to develop an interactive dashboard that uses data visualisation to monitor the mental health of students. The dashboard helps users better understand student well-being and supports early awareness. Interactive dashboards can help monitor and analyse students ' mental health easily (Masrom et al., 2023).

2 Methodology

This study used the CRIPSP -DM methodology. First, the problem, goals, and plan of the project are determined from previous studies (Campbell et al., 2021). The student's mental health data was then collected from online resources, which include Kaggle, and analysed using big data techniques (Hu et al., 2022). The data is then prepared and cleaned for proper use. In order to display the data more clearly, interactive dashboards were developed afterwards using Power BI (Yoo & De Choudhury, 2019). The dashboard has been tested with users to find out if it is useful or not through User Acceptance Testing (UAT). Ultimately, the dashboard has been enhanced so that it is easier for users to view student mental health information (Masrom et al., 2023).

3 Results/Findings

The findings of this study show that interactive dashboards provide mental health information to students in an easy-to-understand and concise manner. Using interactive filters and charts, users can see mental health trends. According to the results of user acceptance tests, the majority of users were satisfied with the usability and clarity of the dashboard. Visualisations help users understand and increase awareness of students ' mental health problems. Overall, studies show that combining structured data analysis with a user-centered dashboard design can support awareness of mental health and encourage students to interact with mental health topics more actively.

4 Novelty of Project/Product/Project

This project introduces an interactive dashboard for monitoring student mental health using the CRISP-DM method. The dashboard allows users to explore mental health information through simple filters and charts, in contrast to conventional reports and surveys. Using Power BI can simplify data interaction and enhance understanding. The dashboard enhances students' understanding of mental health patterns by combining interactive design and structured data analysis. The project offers new and useful methods to raise mental health awareness and support early understanding among university students.

5 Conclusion or Future Work

In general, the developed application successfully achieved its main objective of providing an interactive dashboard to monitor student mental health. The results also indicate that the system is useful, easy to use, and accepted by users. But in the future, some improvements can be made, such as accuracy can be improved by using larger and more diverse data sets, and predictive analytics features can be added to aid in early risk detection. Better user guidance and real-time data updates can also improve usability. Overall, these future improvements could improve the impact and effectiveness of the dashboard.

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VISUALIZING CRITICAL HABITAT PATTERNS USING BIG DATA TECHNIQUES FOR ECOLOGICAL INSIGHT

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Abstract

Ecological datasets have increased in volume and complexity, making traditional methods insufficient for interpreting spatial patterns of critical habitats. Effective visualization is therefore essential to support conservation and data-driven decision-making. This study developed a big data–driven visualization system for critical habitat analysis using the CRISP-DM framework. A large spatial dataset from the U.S. Government's open data portal was processed in Python, stored in Hadoop Distributed File System (HDFS), managed using Apache Hive for scalable querying, and visualized through an interactive Power BI dashboard. The system enabled clearer identification of habitat trends, spatial distributions, and temporal changes. Usability evaluation showed improved user understanding and easier recognition of ecologically sensitive areas. Overall, integrating big data infrastructure with interactive visualization enhances ecological insight and supports informed conservation planning.

Keywords: Critical Habitat, Big Data, Data Visualisation, Ecological Insight, Usability Evaluation

1 Introduction

Critical habitats are essential in sustaining the natural ecological balance and the diversity of life. Researchers have a difficult time managing and interpreting complex ecological information when there is an overload of environmental data coming from various sources, such as observational records and geospatial datasets (Navarra et al., 2021). Most conventional methods of data processing are insufficient for dealing with big data features, i.e. volume, variety, and velocity. Hence, there is a necessity for powerful visualisation tools that can effectively convert vast ecological data into valuable insights visuals (Lacey & Nelson, 2023). This work intends to create a visualisation system that facilitates the study of patterns in critical habitats through big data, enabled approaches.

2 Methodology

This study adopted the CRISP-DM framework to structure the data mining and system development process. A large spatial dataset from the U.S. Government's open data portal was cleaned, pre-processed, and explored using Python in Jupyter Notebook. The processed data were stored in Hadoop Distributed File System (HDFS) and managed through Apache Hive to enable scalable querying and distributed analysis of habitat patterns and temporal changes (Ikegwu et al., 2022). The results were visualized using an interactive dashboard developed in Power BI to present spatial distributions and habitat trends effectively. A structured questionnaire was administered to evaluate the system's usability and its effectiveness in supporting data interpretation and decision-making.

3 Results / Findings

The results show that the dashboard effectively visualized habitat patterns and simplified the interpretation of complex spatial data. Users were able to identify trends, detect temporal changes, and recognize ecologically sensitive areas more efficiently. The integration of

distributed storage, scalable querying, and interactive visualization improved system performance and analytical capability. Usability evaluation also indicated positive perceptions of clarity, information presentation, and ease of interaction. Overall, the findings demonstrate that big data–driven visual analytics enhance ecological data interpretation and support informed conservation planning.

4 Novelty of Project

This project is innovative in its use of distributed big data technologies (HDFS and Apache Hive) combined with interactive dashboard visualisation for the ecological habitat analysis. Traditional methods of ecological reporting are mainly focused on static statistical summaries, but this system is more geared towards scalable processing and dynamic visual exploration of spatial patterns. The project provides a real, world example of the implementation of big data architecture in the field of ecological conservation, thus integrating computer science methods with environmental applications.

5 Conclusion / Future Work

Overall, this study shows that integrating big data techniques with interactive visualization effectively supports the analysis of critical habitat patterns and improves spatial understanding for better conservation decision-making. Future work may include incorporating real-time ecological data, applying predictive analytics for habitat risk forecasting, and expanding the dashboard with additional environmental indicators for comprehensive monitoring.

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INTERACTIVE VISUALISATION DASHBOARD FOR HARMFUL SUBSTANCES IN COSMETIC PRODUCTS

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Abstract

The increasing use of cosmetic products has raised growing concerns regarding the presence of harmful chemical substances in these products. Although regulatory bodies monitor cosmetic safety, many consumers still lack awareness due to complex ingredient labels, scattered information, and limited access to clear safety references. This situation may lead to uninformed purchasing decisions and potential long-term exposure to harmful chemicals. Therefore, this project developed an interactive visualisation dashboard to identify, classify, and present harmful substances found in cosmetic products in a clear and user-friendly manner. The system was developed using the Waterfall methodology, which consists of planning, analysis, design, build, testing, and documentation phases to ensure systematic development. Data were extracted from trusted sources and processed using an Extract, Transform, and Load (ETL) approach to ensure accuracy and consistency before being stored in a Hive data warehouse and visualised using Power BI. User Acceptance Testing (UAT) based on the Technology Acceptance Model (TAM) was conducted to evaluate usability and acceptance. The findings indicate a high level of user satisfaction, with an overall acceptance rate of 85.2% and all evaluation criteria scoring above 4.00. These results demonstrate that the dashboard is functional, easy to use, and effective in supporting informed cosmetic purchasing decisions. Future improvements may include real-time data integration, smart risk alerts, and enhanced visual interactivity.

Keywords: Cosmetic Safety, Data Visualisation, Dashboard, ETL Process, User Acceptance Testing

1 Introduction

Cosmetic products are widely used in daily life, yet some contain chemical substances that may pose health risks. Exposure to these chemicals may lead to allergic reactions, toxicity, and long-term health effects (Wirtu, 2024). Substances such as parabens, phenols, and phthalates have been linked to potential health complications (Kazemi et al., 2022). However, many consumers still face difficulty interpreting ingredient labels and evaluating product safety due to limited scientific knowledge (Hartmann & Klaschka, 2017). To address this issue, this project developed an interactive dashboard that transforms complex cosmetic data into clear visualisations by integrating risk classification and trend analysis to improve transparency and consumer awareness of cosmetic safety.

2 Methodology

This study adopted the Waterfall methodology to ensure a structured development process. The project started with the planning and analysis phases where the problem statement, objectives, system requirements, and datasets were identified. During the design phase, dashboard layouts were created using Figma and data modelling was prepared to organise the database structure. In the build phase, the Extract Transform and Load process was performed, where data were extracted in CSV format, cleaned and standardised using Python in Jupyter Notebook, and then loaded into a Hive data warehouse. The processed data were connected to Power BI to develop the interactive dashboard. In the testing phase, functionality testing was conducted by an expert and User Acceptance Testing was carried out using the Technology Acceptance Model before completing the final documentation.

3 Results / Findings

The findings of this study show that the developed dashboard achieved strong functionality and high user acceptance. Functionality testing recorded a 100 percent success rate for website and dashboard features. User Acceptance Testing showed an overall acceptance rate of 85.2 percent, with all evaluation constructs scoring above 4.00. These results indicate that the dashboard is easy to use, useful, and effective in supporting understanding of harmful cosmetic substances and informed decision making.

4 Novelty of Project / Product / Project

This project introduces an interactive visualisation dashboard that integrates data processing, risk classification, and business intelligence tools into a single cosmetic safety platform. Data visualisation helps simplify complex information and improve understanding (Verma, 2024). Unlike traditional static reports, this system combines ETL processing, Hive data warehousing, and Power BI interactive visualisation to present harmful cosmetic substances in a clear and structured format. The dashboard not only identifies chemicals in cosmetic products but also classifies them based on risk level and health impact. It also provides Malaysia and global comparison as well as future trend forecasting. This integrated and consumer focused approach represents the main novelty and contribution of the project.

5 Conclusion or Future Work

In conclusion, the developed dashboard successfully transforms complex cosmetic chemical data into clear and interactive visualisations. The system achieved high functionality performance and strong user acceptance with an overall rate of 85.2 percent. These findings confirm that the project objectives were achieved. Future improvements may include real time data updates, smart risk alerts, and expanded data coverage to enhance system reliability and impact.

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PersonaTrip: PERSONALITY-DRIVEN TRAVEL VISUALISATION DASHBOARD FOR GEN Z TRAVELERS

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Abstract

PersonaTrip is a personality-driven travel visualisation dashboard developed to support Generation Z travellers in making informed and budget-conscious travel decisions. Existing travel platforms often present generic information with limited visual support, making it difficult for young travellers to analyse destinations, costs, and travel patterns effectively. This study aims to design and develop a dashboard that visualises tourism data and personality-related travel preferences to enhance trip planning clarity and decision-making. CRISP-DM methodology was adapted in developing PersonaTrip, covering requirement analysis, data preparation, dashboard development, and evaluation. User Acceptance Testing (UAT) involving Gen Z users indicated high usability and usefulness, with mean scores above 4.0 for perceived ease of use, perceived usefulness, attitude towards using and behavioural intention to use. Overall, PersonaTrip demonstrates the potential of visual analytics in supporting self-planned travel and aligns with Sustainable Development Goal 9 by promoting digital innovation in tourism.

Keywords: Data visualisation, Gen Z travellers, Personality traits, Tourism analytics, Travel dashboard, User acceptance testing (UAT)

1 Introduction

Generation Z travellers increasingly rely on digital platforms and social media to plan their trips. Studies show that social media significantly influences destination choice and travel preferences among Gen Z (Demiris et al., 2025). However, most existing travel platforms focus primarily on booking services and itinerary management rather than providing meaningful visualization of complex travel data. This often leads to information overload, inefficient decision-making, and overspending, particularly among budget-conscious young travellers. Research also highlights that personalization and structured itinerary planning improve travel satisfaction (Ghobadi et al., 2023; Halder et al., 2024).Therefore, this project introduces PersonaTrip, a personality-driven travel visualization dashboard designed for Generation Z travellers aged 18–28, particularly students of Higher Education Institutions (HEIs). The objectives of this project are: (i) to identify the need for a personalized and budget-friendly travel recommendation approach, (ii) to design and develop an interactive dashboard for analysing tourism trends and cost patterns, and (iii) to evaluate the usability and effectiveness of the system through User Acceptance Testing (UAT). The scope focuses on integrating personality traits (MBTI), travel preferences, and budget constraints with tourism datasets obtained from credible secondary sources such as Kaggle and the Department of Statistics Malaysia (DOSM). The dashboard presents insights through interactive visualizations to support informed and cost-effective travel planning.

2 Methodology

The study adapted the CRISP-DM methodology, consisting of five phases: Business Understanding, Data Understanding, Data Preparation, Development, and Evaluation. Relevant tourism and user survey datasets were collected, cleaned, transformed, and stored using appropriate data handling techniques. The dashboard was developed to visualise travel trends, demographic insights, and personality-related preferences. System evaluation was

conducted through functionality testing and User Acceptance Testing (UAT) to assess usability and effectiveness from the users' perspective.

3 Results / Findings

The evaluation results indicate that PersonaTrip was well accepted by users, particularly among Gen Z participants. Based on UAT analysis using the Technology Acceptance Model (TAM), the dashboard achieved high mean scores for perceived ease of use, perceived usefulness, and behavioural intention to use, all exceeding 4.0 on a five-point Likert scale. Users reported that the visualisation features helped them understand travel patterns and plan trips more efficiently, demonstrating the effectiveness of the dashboard as a decision-support tool.

4 Novelty of Project / Product / Project

The novelty of PersonaTrip lies in its integration of personality-related insights with interactive travel data visualisation within a single dashboard. Unlike conventional travel platforms that focus on textual recommendations, PersonaTrip emphasises visual analytics to support exploration, comparison, and understanding of travel information, specifically tailored to Gen Z travellers' preferences and decision-making behaviour.

5 Conclusion or Future Work

In conclusion, PersonaTrip successfully demonstrates how a personality-driven travel visualisation dashboard can enhance travel planning among Gen Z users. The system improves clarity, usability, and confidence in self-planned travel decisions through effective data visualisation. Future work may include incorporating real-time tourism data, expanding visual interactivity, and extending the dashboard to support broader demographic groups and predictive travel trend analysis.

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INTERACTIVE ANALYTICAL DASHBOARD FOR SLEEP QUALITY AMONG PATIENTS USING BIG DATA ANALYSIS

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Abstract

The quality of sleep is essential for maintaining physical health, mental well-being, and daily performance. However, sleep data related to lifestyle is often overlooked because the data sources are inconsistent and the tools for analysing them are inadequate. This research presents a proof-of-concept big data analytics system designed to analyse lifestyle factors influencing sleep quality, perform predictive analyses, and visualise insights through an interactive dashboard. A synthetic dataset comprising 5,001 records obtained from Kaggle was used, including variables such as sleep duration, physical activity, and stress level. The research utilises the Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology, integrating preprocessing with Apache Hadoop, predictive modelling through random forest regression, and visualisation via Power BI. Model evaluation produced an RMSE of 2.793 and an R^2 of −0.0003, indicating limited predictive accuracy when using synthetic data. Despite this limitation, the system demonstrates an end-to-end analytics pipeline and supports interactive exploration of lifestyle–sleep correlations. User acceptance testing confirmed that the dashboard is user-friendly and provides valuable information. This research highlights the advantages of big data analytics and visualisation in sleep-related research and lays foundations for future enhancements using real-world healthcare data.

Keywords: Sleep Quality, Lifestyle Factors, Big Data Analysis, Interactive Dashboard, Machine Learning

1 Introduction

Quality sleep is essential for an individual's health and well-being, particularly for those affected by the stress and pressures of modern life (Qiu et al., 2022). Various factors, including the frequency of physical exercise, stress levels, and daily routines, have been identified as determinants of sleep quality (Korkutata et al., 2025). Although there is often a wealth of data concerning sleep quality in relation to lifestyle, the limited amount of available data and the use of traditional techniques make the process difficult to analyse. This project aims to develop an interactive analytical dashboard for big data using machine learning techniques.

2 Methodology

The proposed research study has followed the Cross-Industry Standard Process for Data Mining (CRISP-DM). To create synthetic data, this research used 5,001 records from the Kaggle dataset (Adil Shamim, 2025), which provided information on various aspects of sleep and lifestyle. The ETL process was executed through batch processing using Python and the Apache Hadoop framework. Data preprocessing tasks, including data cleaning, missing value handling, normalisation, encoding, and transformation, were conducted to enhance data quality prior to (Çetin & Yıldız, 2022). The Predictive analysis was performed using the forest regression method, model performance was evaluated using RMSE and R^2. The results were displayed through the use of Power BI, together with user acceptance testing.

3 Results /Findings

The Random Forest regression model successfully managed to obtain an RMSE value of 2.793 and an R^2 value of -0.0003. The R^2 value points to the limitations in predictive capability,

particularly when using synthetic sleep data. Nevertheless, the system succeeded in proving the viability of an entire big data analytics workflow, which consists of data preparation, large data processing via the Apache Hadoop system, prediction via machine learning, and interactivity in visualisation. The Power BI dashboard supports exploration of relationships between sleep duration, physical activity, stress level, and sleep quality through interactive filtering and analysis. User acceptance testing indicated that the interface is user-friendly and effective in showing the relationship between lifestyle and sleep.

4 Novelty of Project

This research combines big data analytics, machine learning, and interactive visualisation to understand sleep quality. Most earlier studies on sleep have focused independently on either statistical analysis or the development of predictive models; in contrast, the study at hand proposes to build an "end-to-end" model using the CRISP-DM approach. Unlike most research that would only produce static result data, this research offers interactive analysis with an analytical dashboard that can enable interaction in exploring lifestyle factors and their association with sleep quality. It is original in its utilisation of Apache Hadoop for scalable data preprocessing, Random Forest regression for predictive modelling, and Power BI for visual analytics. Furthermore, acceptance testing by users ensures that the system under development is functional. The contribution of this research to health informatics is demonstrating an interactive and reproducible framework for sleep quality analytics.

5 Conclusion or Future Work

In conclusion, the interactive analytical dashboard that has been developed demonstrates the application of big data processing, machine learning, and visual analytics for sleep quality analysis. Due to the limitations in predictive performance caused by the synthetic dataset, the system supports exploratory analysis and provides meaningful visual insights, which are backed by positive usability feedback. Future work should integrate real-world clinical and wearable sensor data, include additional physiological variables, explore alternative machine learning techniques, and enable real-time analytics to improve predictive performance and practical applicability.

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FLOOD PREDICTION IN MALAYSIA USING MACHINE LEARNING TECHNIQUE

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Abstract

Flood disasters frequently affect Malaysia, causing damage to property, infrastructure, and community safety. The increasing variability of rainfall and monsoon behaviour requires more adaptive and data-driven prediction approaches compared to traditional rule-based methods. This study proposes a machine learning flood prediction system using historical rainfall records from the Malaysia Flood Dataset (2000–2010). Data preprocessing, cleaning, and feature preparation were performed before model training. A Random Forest regression model was developed to estimate future rainfall and translate the outputs into flood risk levels through predefined thresholds. The model achieved an Root Mean Squared Error (RMSE) of 45.12 mm, Mean Absolute Error (MAE) of 25.82 mm, and a coefficient of determination (R^2) value of 0.81, indicating strong capability in capturing rainfall variability. The prediction service was deployed through an interactive Streamlit dashboard that allows users to explore national and state-level trends. Usability evaluation shows high acceptance, with an overall satisfaction score of 4.08 out of 5. These results demonstrate that the proposed system can support flood awareness, risk interpretation, and data-driven decision-making while remaining accessible to non-technical users.

Keywords: Flood prediction, Machine learning, Random Forest, Rainfall modelling, Decision support

1 Introduction

Flooding remains one of the most serious environmental challenges in Malaysia, largely influenced by monsoon seasons, rapid urban development, and changing climate patterns. Accurate early prediction is essential because delayed warnings can increase economic losses and threaten public safety (Maspo et al., 2020). Machine learning methods are increasingly adopted as they are capable of modelling nonlinear environmental relationships without relying on strict physical assumptions (Khairudin et al., 2022). Among available approaches, Random Forest has demonstrated strong performance and robustness in rainfall and flood modelling (Razali et al., 2020). Motivated by these advantages, this project develops a Malaysian flood prediction system using historical rainfall data and presents the outputs through an interactive visual dashboard to improve accessibility of analytical results.

2 Methodology

Historical rainfall data covering the period 2000–2010 were obtained from the Malaysia Flood Dataset. The workflow involved exploratory data analysis, data cleaning, removal of inconsistencies, and preparation of input variables suitable for regression modelling. The dataset was divided into training and testing sets before implementing the Random Forest Regressor using Scikit-learn. Model performance was evaluated using RMSE, MAE, and R^2 to measure prediction reliability. The final trained model produced an RMSE of 45.12 mm, MAE of 25.82 mm, and R^2 of 0.81, demonstrating the ability to explain 81% of rainfall variation. The regression outputs were then converted into Low, Medium, and High risk categories and integrated into a Streamlit-based dashboard for interactive visualisation.

3 Results / Findings

The evaluation results indicate that the model maintains stable predictive behaviour across historical rainfall conditions. Error magnitudes remain relatively small when compared with the operational flood risk thresholds, reducing the likelihood of incorrect risk categorisation. Usability testing involving target users further demonstrates strong system acceptance. The usefulness dimension recorded a mean score of 3.83, while overall satisfaction achieved 4.08. Users particularly valued decision support capability (M=4.16) and clarity of risk understanding (M=4.06). These findings confirm that the combination of machine learning prediction and visual analytics enables effective communication of flood information.

4 Novelty of Project / Product / Project

This project introduces a practical integration between a Random Forest regression engine and an accessible web-based visual environment tailored to Malaysian rainfall characteristics. Unlike systems that present only raw numerical outputs, the developed platform transforms predictions into colour-coded and interpretable flood risk indicators. The dual-level modelling strategy, which supports both national and state analysis, enhances contextual interpretation and broadens applicability for disaster preparedness and planning.

5 Conclusion or Future Work

The project verifies that machine learning can reliably support rainfall-driven flood estimation using structured historical data. With R^2 reaching 0.81 and high user satisfaction exceeding 4.0, the system demonstrates both analytical strength and practical usability. Future enhancement may focus on incorporating real-time meteorological feeds, richer environmental variables, automated alerts, and extended comparative analytics to further improve prediction timeliness and operational value.

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EXPLORING FOREIGNER ARRIVALS IN MALAYSIA: INTEGRATING POWER BI AND APACHE HIVE

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Abstract

Foreigner arrival data plays a crucial role in supporting tourism development, immigration planning, and economic growth in Malaysia. However, the increasing volume of tourism-related data, together with fragmented, static, and non-interactive reporting practices, has limited stakeholders' ability to conduct in-depth analysis and make evidence-based decisions. This project aims to analyse and visualise trends in foreigner arrivals to Malaysia from 2020 to 2024 by integrating big data processing techniques with interactive data visualisation. The Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology was adopted to guide the project phases, including data understanding, preparation, analysis, development, and evaluation. Publicly available tourism datasets were processed using Apache Hive to perform large-scale data cleaning, transformation, and aggregation. Microsoft Power BI was then utilised to develop an interactive dashboard that allows users to explore foreigner arrival patterns based on nationality, state of entry, gender, and temporal trends through dynamic filters and drill-down features. System evaluation was conducted using functional testing, heuristic evaluation, and the Technology Acceptance Model (TAM). The evaluation results indicate high user acceptance, with mean scores exceeding 4.4 across perceived usefulness, perceived ease of use, attitude toward use, and intention to use. Overall, the findings demonstrate that the developed dashboard effectively transforms complex tourism data into meaningful insights and supports a clearer understanding of post-pandemic foreigner arrival trends in Malaysia.

Keywords: Foreigner Arrivals, Tourism Analytics, Big Data Analytics, Power BI, Apache Hive

1 Introduction

Tourism is a major contributor to Malaysia's economic growth and employment, with international tourist arrivals playing a vital role in sustaining the sector, particularly following the COVID-19 pandemic and the recovery from 2022 onwards (Elleine Ruzdeana Ortega et al., 2023) However, analysis of post-pandemic foreigner arrival patterns remains limited due to tourism data being presented in static and fragmented formats that restrict interactivity (Jiménez-Partearroyo et al., 2024). This project addresses these limitations by developing an interactive dashboard for analysing foreigner arrivals in Malaysia using big data processing and data visualisation techniques. The objectives of this study are to analyse arrival trends based on demographic and spatial variables, to design and develop an interactive dashboard using Microsoft Power BI, and to evaluate its usability using the Technology Acceptance Model (TAM) (Ezra et al., 2021). The project processes tourism datasets from 2020 to 2024 using Apache Hive prior to visualisation. Overall, the dashboard supports tourism planning, immigration management, and data-driven decision-making in Malaysia.

2 Methodology

This study used the Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology as a structured framework to manage the end-to-end data analytics process. The methodology began with the Business Understanding and Data Understanding phases to identify the need for a centralized interactive platform and to collect tourism datasets from 2020 to 2024 from publicly available sources. In the Data Preparation phase, Apache Hive was utilised for large-scale data cleaning, transformation, normalization, and aggregation to ensure data accuracy and consistency. The processed data were then visualised in the Development

phase using Microsoft Power BI through interactive dashboards with charts, filters, and drill-down features. Finally, the Evaluation phase involved functional testing, heuristic evaluation, and user acceptance assessment based on the Technology Acceptance Model (TAM), with user feedback used to refine the dashboard's usability and design.

3 Results / Findings

The findings of this study show that the interactive dashboard effectively visualises foreigner arrival trends in Malaysia by nationality, state of entry, gender, and year, enabling exploration of key patterns such as major source countries and seasonal variations. The Technology Acceptance Model (TAM) evaluation indicates strong user acceptance, with mean scores above 4.4 across all dimensions. Users found the dashboard clear, easy to use, and more effective for analysis than traditional static reports. Overall, the results demonstrate that integrating Apache Hive with Microsoft Power BI enhances the scalability and analytical capability of tourism data visualisation for large datasets.

4 Novelty of Project / Product / Project

This project presents a novel approach to analysing foreigner arrival trends in Malaysia by integrating big data processing and interactive visualisation using Apache Hive and Microsoft Power BI. The dynamic, user-driven analytics dashboard supports deeper demographic and spatial analysis for smart tourism planning and evidence-based decision-making.

5 Conclusion or Future Work

The interactive dashboard demonstrates the effectiveness of integrating big data processing and data visualisation for analysing foreigner arrival trends in Malaysia and supporting tourism planning, immigration management, and data-driven decision-making. Future enhancements may include integrating real-time or authoritative government data sources, as well as predictive analytics and forecasting features to support strategic tourism planning.

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MINDAURA: MOBILE APPLICATION FOR EMOTIONAL HEALTH & WELLNESS

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Abstract

Depression, anxiety, and stress are other mental health issues that are affecting young adults at a faster pace and having adverse effects on their everyday operations. Most of the current mental health apps offer broad wellness applications but do not offer standardized screening and customized feedback systems (Mohr et al., 2017). To overcome these shortcomings, a mobile application called Mind Aura was created to assist in managing emotional health by means of early screening and self-monitoring. Rapid Application Development (RAD) system was used to develop the system. Firebase Authentication was applied to use as the backend authentication service, Flutter was employed as the frontend developer, and Cloud Firestore was utilized as a database in this project. The application has mental health screening tools such as GAD-7 and DASS-21 and also other features such as mood tracking, wellness goals, relaxation exercises, and recommendation modules. Functionality testing was performed on 14 modules to maintain the correct functionality of the system. The Usability testing was performed with 16 respondents and the User Acceptance Testing (UAT) was carried out with 14 actual users in terms of Technology Acceptance Model (TAM). The outcomes reveal that the functionality test cases had been successfully executed. In addition, 93.6 percent of the respondent stated that the system is user friendly and 91 percent of the users gave positive results to UAT testing. The personalization with the use of artificial intelligence and combination with professional mental health referral services may be improved in the future.

Keywords: Mental Health, Mobile Application, GAD-7, DASS-21, Emotional Wellness

1 Introduction

Common mental health problems that have a great impact on emotional well-being and productivity are depression, anxiety, and stress. The presence of persistent sadness and the absence of interest in everyday life is one of the typical symptoms of depression that may have a harmful impact on personal and professional life (Richter et al., 2021). Over the last few years, mental health monitoring based on digital technologies with the implementation of mobile health applications became more popular (Torous et al., 2021). Despite the large number of mental health applications, most of them offer general wellness features and do not have standardized screening tools or tailored advice to their users (Mohr et al., 2017). In the absence of validated screening tools, users will not be provided with accurate information about their emotional conditions. Thus, Mind Aura was created as the platform of the structured mental health screening and self-monitoring via a mobile application. The app combines the standardized psychological tools like GAD-7 and DASS-21 that have been popularized to evaluate the symptoms of stress, anxiety, and depression (Singh and Kumar, 2021).

2 Methodology

A mobile emotional health management system has been created to overcome the shortcomings of current mental health applications. The system also allows users to do GAD-7 and DASS-21 tests, mood journal, wellness goal management, and relaxation and recommendation tools. The system has been created based on the Rapid Application Development (RAD) model that favors the iterative development process and constant user feedback. The Firebase

Authentication was adopted as a secure user authentication method, Flutter was adopted as an application user interface, and Cloud Firestore was adopted as a real-time database. A number of testing methods were used in system evaluation. During the functionality testing, 14 modules were tested to ensure that the system components worked properly. To test user interaction and user navigation, Usability testing was done on 16 respondents. Also, User Acceptance Testing (UAT) was performed on 14 real users according to the Technology Acceptance Model (TAM) in order to assess the perceptions of usefulness and ease of use.

3 Results / Findings

The findings of this study show that all features and functionalities of the system are working as intended, responses from respondents indicate that the system is easy to use, and the system is suitable for individuals seeking mental wellbeing support. The result of all the test cases evaluated during functionality testing shows a 100% success rate. Furthermore, 93.6% of respondents found that the system is easy to use. Based on the User Acceptance Test (UAT), 91% of real users gave positive feedback and agreed that the application supports mental health awareness.

4 Novelty of Project / Product

This mobile app joins standardized screening tools (GAD-7 and DASS-21) and integrations with real-time Firebase databases along with role-based access control in one application.

5 Conclusion or Future Work

Overall, the designed application brings out its goal of delivering an easy to use and safe mental health care support platform. The application could also be enhanced in the future by adding personalization through artificial intelligence and professional mental health referral options.

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SMART ATTENDANCE SYSTEM USING FINGERPRINT RECOGNITION FOR COMPUTER SCIENCE STUDENTS AT UiTM ARAU

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Abstract

The manual attendance system at educational institutions, particularly at Universiti Teknologi MARA (UiTM) Arau, is prone to inefficiencies, errors, and dishonest practices such as proxy attendance. This study presents the development of a Smart Attendance System using fingerprint recognition to automate and secure attendance tracking for Computer Science students. The system leverages biometric technology to uniquely identify students and record their attendance in real-time, reducing administrative workload and increasing data accuracy. A user-friendly mobile interface was designed for both students and lecturers, enabling seamless attendance management. Usability and performance evaluations were conducted with 30 student participants, resulting in high satisfaction scores for reliability, security, and ease of use. The findings demonstrate that integrating fingerprint recognition into attendance management significantly improves accuracy and prevents fraudulent attendance practices. The developed system also provides an efficient digital record of attendance history that can be accessed by faculty and students. This paper outlines the system design, methodology, and evaluation outcomes, highlighting its potential for broader application in educational settings.

Keywords: Fingerprint Recognition, Attendance System, Biometric

1 Introduction

Attendance management is a critical administrative task that affects academic performance monitoring and discipline. At UiTM Arau, traditional methods such as manual sign-in sheets and roll calls are time-consuming and vulnerable to human errors and fraudulent practices. Proxy attendance, where students mark attendance for absent peers, compromises the integrity of attendance records. There is a clear need for an automated, reliable, and secure system that streamlines the attendance process while ensuring data accuracy. Fingerprint recognition technology provides a viable solution, offering unique biometric identification that cannot be easily replicated or forged.

2 Methodology

This study adopted a design and development research approach to create a mobile-based Smart Attendance System. The system architecture integrates an Android application, a cloud database for secure storage, and biometric fingerprint sensors for student identification. Fingerprint enrolment and authentication modules were implemented to register and verify students uniquely. Cloud services were employed to store attendance records and facilitate real-time updates. Usability and performance evaluations were conducted with 30 student participants, using questionnaires and observation to assess reliability, responsiveness, and overall satisfaction. Data collected were analysed to measure system effectiveness and identify areas for improvement.

3 Results / Findings

The developed system successfully automated the attendance process and prevented proxy

attendance. Students were uniquely identified through fingerprint recognition, and attendance data were securely stored in the cloud database. Evaluation results showed high user satisfaction, with average ratings between 4.77 and 5.00 for usability, reliability, and data security. Lecturers reported significant reductions in time spent on attendance recording, while students appreciated the convenience of mobile access. The system demonstrated real-time synchronization, accurate attendance logging, and robust security measures, confirming its effectiveness in improving attendance management.

4 Novelty of Project / Product / Project

This mobile application integrates biometric fingerprint recognition with cloud-based data management for attendance tracking. Unlike conventional methods, it offers:

- Unique biometric authentication for every student
- Prevention of proxy attendance
- Real-time recording and access to attendance history
- High usability and security features

The novelty lies in combining fingerprint recognition with a mobile-cloud infrastructure, providing a scalable and secure solution for educational institutions.

5 Conclusion or Future Work

The Smart Attendance System using fingerprint recognition effectively addresses the challenges of manual attendance tracking at UiTM Arau. It improves accuracy, enhances security, and reduces administrative workload. Future enhancements may include multi-biometric authentication, integration with facial recognition, and expansion to other faculties or institutions to provide a comprehensive attendance management solution.

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AURO: A CROWDSOURCED CAMPUS SAFETY APP

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Abstract

The issue of campus safety remains a significant concern in higher learning institutions because of the underreporting of such incidents and the delay in communication between the students and the campus officials. In Universiti Teknologi MARA (UiTM) Arau, the current safety communication is largely based on manual reporting and informal peer channels which do not provide sufficient real time situational knowledge. This article introduces AURO an open-source mobile app that can help improve the safety of campuses by allowing users to report incidents anonymously and get real-time notifications based on their location. Firebase Authentication and Firebase Cloud messaging were used to provide an opportunity to manage the data safely and to display it in geospatial form. The requirement analysis, system design, development, testing and documentation were conducted using the Waterfall methodology. The core modules were tested to ensure that they worked as expected and the usability testing done with UiTM Arau students showed that users were highly satisfied with the interface design and interface usability. The results show that AURO is technically viable and positively accepted by users. AURO enhances safety in campus by engaging in crowdsourcing, and real-time geolocation within a campus-specific framework.

Keywords: Campus Safety, Crowdsourcing, Mobile Application, Real-Time Alerts, Anonymous Reporting.

1 Introduction

Campus safety plays a crucial role towards providing a safe and enabling learning experience in colleges. Nevertheless, there are cases of harassment, thievery, bullying, and other forms of safety hazards that are not reported because of the fear of being victimized, anonymity, and inability to access effective reporting mechanisms. Research shows that underreporting has a major effect on lower institutional responsiveness as well as undermines trust between students and authorities (Messman et al., 2024). The existing safety communication systems at UiTM Arau rely heavily on manual reporting systems and informal communication of information. These strategies do not provide distribution of alerts in real-time and organised data gathering, which results in delayed reaction and diminished situational awareness of students. Lack of a centralized online platform also prevents the monitoring of the patterns of incidents in campus authorities in the systematic way. In response to these constraints, the current project will suggest the use of AURO, a crowdsourced campus safety mobile application that allows anonymously reporting accidents and receiving real-time and location-based notices.

2 Methodology

This study used the Waterfall methodology to design and implement the AURO mobile application systematically in the stages of requirement analysis, system design, development, and testing. A survey of UiTM Arau students was conducted via a Google Form survey to gather requirement data to understand the safety concerns and user needs. Prototypes of the user interface and system model are created with the help of Figma and UML diagrams to facilitate role-based architecture. It is developed using Flutter combined with Firebase Authentication, Firebase Cloud Messaging, Firestore, and Google Maps SDK to provide the opportunity to use secure real-time reporting and visualize alerts. To assess the performance of the system and the satisfaction of the users, functionality testing based on a black-box and usability testing based on the UiTM Arau users were performed.

3 Findings

The findings of this study show that the AURO mobile application is dependable and achieves its desired purposes in the UiTM Arau context. Functionality tests ensured that all the fundamental modules, such as user authentication, anonymous incident reporting, real-time alerts broadcasting, push, and safety map visualization, worked as anticipated without any essential faults. The usability testing that was conducted with UiTM Arau students and staff revealed that there is a high degree of user satisfaction especially in the areas of ease of navigation, clarity of the interface as well as responsiveness of the system.

4 Novelty of Project

This mobile application uses a crowdsourced model that combines anonymous reporting, real-time location alerts, and role-based dashboards into a campus-specific safety model. Compared to other current safety applications, e.g., FixCyprus and SPaFE that are predominantly the infrastructure and the route safety oriented (Christou et al., 2023; Hossain et al., 2022), AURO is designed at university setting and has students connected to campus authorities directly. The system has the only provider of geospatial visualization of incidents and secure Firebase-based infrastructure, multi-role access control to ensure better situational awareness and administrative control.

5 Conclusion or Future Work

Overall, the developed application proves that a crowdsourced mobile application can be used to enhance the effectiveness of campus safety communication in UiTM Arau. The combination of anonymous reporting and real-time notifications will increase user engagement and situational awareness and aid campus officials in tracking events. The successful result of the testing shows that there is a high possibility of deployment in the real-world. Future efforts can be directed at adding predictive analytics, cross platform, and more sophisticated data visualization to reinforce the proactive campus security management further.

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WEB SECURITY ASSESSMENT TOOL UTILIZING NIKTO AND LOGISTIC REGRESSION FOR INSECURE DESIGN VULNERABILITIES

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Abstract

Modern web applications frequently face the critical risk of insecure design, a vulnerability often missed by traditional scanners like Nikto, which suffer from excessive operational noise and fail to interpret the architectural significance of isolated technical findings. This situation necessitates an intelligent automated solution to filter non-critical data and prioritize architectural flaws found in server configurations. This paper presents the design and development of a Web Security Assessment Tool that integrates a logistic regression classifier with TF-IDf vectorization to process Nikto scan outputs. The system automatically distinguishes between non-critical operational noise and genuine risks such as session management flaws and missing security headers. System performance testing demonstrated that the model achieved a validation accuracy of 85.71% and a noise reduction rate of 63.6%. This functional reduction in noise significantly decreases the manual effort required to verify false positives, allowing developers to focus immediately on high-priority design issues while maintaining high operational efficiency with minimal processing latency.

Keywords: Web Security, Insecure Design, Machine Learning, Nikto, Vulnerability Assessment

1 Introduction

Web security is paramount, yet "Insecure Design" (OWASP, 2021) remains a fundamental challenge. Unlike implementation bugs, these are architectural flaws where security controls were never specified. While Dynamic Application Security Testing (DAST) tools like Nikto are essential for runtime analysis, they generate excessive "noise" (false positives) and technical indicators that lack the context to diagnose design weaknesses. This creates a detection gap where high-risk issues are obscured by low-level data. This study addresses this gap by developing a tool that utilizes Machine Learning (ML) to filter Nikto's output, prioritizing genuine insecure design vulnerabilities over operational noise.

2 Methodology

The project utilized the Waterfall Methodology, developing a hybrid system architecture. The frontend was built with React.js (Windows), while the backend utilized Python Flask within the Windows Subsystem for Linux (WSL 2) to execute the Nikto engine natively.

2.1 System Architecture

A supervised learning approach was implemented to classify scan results:

2.2 Machine Learning Pipeline

1. Data Collection: A custom dataset was aggregated by scanning vulnerable environments (DVWA and OWASP Juice Shop).
2. Labelling: Raw logs were manually labeled as "Class 1: Vulnerability" (e.g., missing headers, directory indexing) or "Class 0: Noise" (e.g., server banners).

3. Feature Extraction: Term Frequency-Inverse Document Frequency (TF-IDF) vectorization with an n-gram range of (1, 2) was used to convert text logs into numerical features.
4. Classification: A Logistic Regression model was trained on an 80/20 stratified split of the dataset to predict vulnerability validity.

3 Results / Findings

System performance was evaluated based on filtering efficiency, accuracy, and latency using a Time-Separated Repeated Scan methodology.

3.1 Filtering Efficiency

The raw Nikto engine generated 11 findings per scan on the test target. The ML integration successfully filtered 7 of these as "Noise" (Class 0), achieving a Noise Reduction Rate of 63.6%. The remaining 4 findings were correctly prioritized as high-severity vulnerabilities, such as Insecure Cookie (PHPSESSID) and Information Leakage.

3.2 Accuracy and Latency

The model achieved a validation accuracy of 85.71%. While precision for noise detection was 100%, a false negative was observed for the "X-Frame-Options" header during live testing due to dataset constraints. Operational efficiency remained high; the average scan time was 6 seconds, with ML processing adding negligible latency (<0.1 seconds).

4 Novelty of Project / Product / Project

The novelty of this project lies in the application of Logistic Regression specifically to detecting "Insecure Design" within open-source scanner outputs. Unlike standard tools that produce flat, unprioritized text logs, this tool introduces an intelligent post-processing layer. It bridges the gap between automated data gathering and architectural security review, transforming raw technical artifacts into a curated, noise-free dashboard suitable for developer.

5 Conclusion or Future Work

The Web Security Assessment Tool successfully automates the prioritization of insecure design flaws, reducing manual verification time by over 60%. Future work will focus on expanding the training dataset to diverse web environments to improve recall and integrating deep learning techniques, such as Long Short-Term Memory (LSTM) networks, to better understand complex vulnerability sequences.

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E-MERIT MOBILE APPLICATION USING MULTI-FACTOR AUTHENTICATION FOR UITM

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Abstract

Student participation in co-curricular activities is essential for holistic development, yet the existing web-based E-Merit system at Universiti Teknologi MARA (UiTM) faces critical limitations including poor accessibility, unreliable attendance verification, and low engagement. A preliminary study of 46 UiTM college residents revealed that 100% confirmed QR codes could be shared for proxy attendance, 93.5% found profile management inconvenient, and 89.1% missed events due to inadequate updates. This paper presents an E-Merit mobile application integrating multi-factor authentication combining QR codes, GPS geofencing, and biometric verification for secure attendance tracking. Developed using Flutter and Firebase following the Waterfall Model, the application provides three user modules for students, organizers, and administrators. Functionality testing achieved 100% pass rate across 81 test cases. User Acceptance Testing with 32 participants yielded high mean scores: Perceived Ease of Use (4.28), Perceived Usefulness (4.26), Attitude (4.27), and Intention to Use (4.30), indicating strong user acceptance.

Keywords: E-Merit, multi-factor authentication, QR code, GPS geofencing, biometric authentication, Flutter, Firebase

1 Introduction

Student participation in co-curricular activities is essential for holistic development, yet the existing web-based E-Merit system at Universiti Teknologi MARA (UiTM) suffers from poor accessibility, vulnerable QR code-based attendance susceptible to sharing, and fragmented event information dissemination. A preliminary study of 46 UiTM college residents revealed significant concerns: 93.5% found profile management inconvenient, 100% confirmed QR codes enable proxy attendance, 89.1% missed events due to inadequate updates, and 89.1% agreed gamification elements would enhance engagement. These findings underscore the urgent need for a mobile-based solution addressing accessibility, security, and engagement challenges. This study presents an E-Merit mobile application integrating multi-factor authentication combining QR codes, GPS geofencing, and biometric verification for secure attendance tracking with gamification features.

2 Methodology

This project adopted the Waterfall Model comprising five phases: Requirement Analysis, Design, Development, Testing, and Documentation. The Requirement Analysis phase involved a survey of 46 UiTM college residents and literature review of related works (Liew & Tan, 2021; Chan et al., 2020; Maček et al., 2017). The Design phase utilized Draw.io for flowcharts and ER diagrams, and Figma for prototyping three user modules. The Development phase employed Flutter and Firebase, integrating mobile_scanner for QR codes, geolocator with Haversine formula for GPS, and local_auth for biometrics. The Testing phase conducted Functionality Testing across 81 test cases and User Acceptance Testing with 32 participants evaluating four constructs using a five-point Likert scale.

3 Results / Findings

Functionality testing across Student (27 tests), Organizer (24 tests), Admin (24 tests), and General/System modules (6 tests) achieved 100% pass rate across all 81 test cases. The multi-factor attendance verification system combining QR code scanning, GPS geofencing using the Haversine formula, and biometric authentication successfully prevented proxy attendance, duplicate check-ins, and remote scanning, directly addressing the primary security vulnerability where 100% of preliminary study respondents confirmed QR code sharing was possible. User Acceptance Testing with 32 participants (31 students, 1 expert; 65.6% hostel residents) demonstrated highly positive perceptions: Perceived Ease of Use (PEU) averaged 4.28, with "updating profile with minimal effort" scoring 4.44; Perceived Usefulness (PU) averaged 4.26, with security items scoring highest at 4.41; Attitude (ATT) averaged 4.27, with gamification scoring 4.31; and Intention to Use (IU) averaged 4.30, with 93.8% supporting replacement of the existing web-based system.

4 Novelty of Project / Product / Project

The E-Merit mobile application introduces several novel contributions: first, the integration of three-factor authentication combining QR possession, GPS verification using the Haversine formula with accuracy tolerance, and biometric inference creates a tamper-evident attendance mechanism that systematically prevents the QR code sharing vulnerability identified in 100% of survey respondents; second, a weighted merit calculation system distinguishing between college activities (75% weighting) and non-college activities (25% weighting) provides institutional flexibility with transparent real-time calculation; third, a comprehensive three-role architecture with two-tier approval workflows establishes institutional governance while maintaining efficiency; and fourth, a gamification framework integrating leaderboards and badges addresses the engagement gap, with UAT results confirming 90.7% found these elements engaging.

5 Conclusion or Future Work

The E-Merit mobile application successfully addressed critical limitations in UiTM's web-based system by providing a secure and accessible merit management platform, with multi-factor authentication effectively preventing proxy attendance and receiving strong user acceptance (Intention to Use: 4.30), indicating readiness for institutional adoption. Limitations include exclusive Android testing, internet dependency, and need for university database integration. Future work should focus on iOS optimization, offline capabilities, AI-driven event recommendations, blockchain for immutable records, and longitudinal impact studies.

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BISIK BUDI: EMPOWERING APHASIA RECOVERY THROUGH A MALAY-CENTRIC MOBILE APP

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Abstract

This project addresses communication difficulties faced by individuals with aphasia in speaking, understanding, reading, and writing. A Malay-centric mobile-based Augmentative and Alternative Communication (AAC) application named Bisik Budi was developed to integrate communication support and telerehabilitation features. The system includes an interactive AAC board with text-to-speech, caregiver customization, and therapy modules for reading, writing, listening, and speaking. Developed using the Waterfall SDLC, the evaluation confirmed that all core functionalities operated as expected, with UAT average scores above 4.0 out of 5 and stable network performance. Future work will focus on AI-based adaptive therapy, expanded content, and enhanced offline capabilities.

Keywords: Augmentative, Alternative Communication

1 Introduction

Aphasia is a communication disorder commonly caused by stroke that affects an individual's ability to understand and produce spoken and written language (NIDCD, 2025). In Malaysia, stroke remains a major contributor to long-term disability, increasing the demand for speech and language rehabilitation (Tan & Venketasubramanian, 2022). Although AAC tools support communication recovery, many applications are designed for English-speaking and Western contexts, creating linguistic and cultural barriers for Malay-speaking elderly users (Muttiah et al., 2022). Telerehabilitation technologies further highlight the potential of digital solutions to improve accessibility and continuity of care (Nicolas et al., 2024). Therefore, a culturally localized and accessible mobile-based AAC solution is needed in the Malaysian context.

2 Methodology

The development of the Bisik Budi application followed the Waterfall Software Development Life Cycle (SDLC), consisting of the Requirement, Design, Development, Testing, and Reviewing phases. The Requirement phase involved literature review, analysis of existing AAC tools, and expert consultation to identify system gaps and user needs. The Design phase focused on system architecture, database structure, and user interface prototyping for aphasia patients and caregivers. The application was developed using Flutter for the front-end and Firebase for authentication, real-time database management, and multimedia storage. Testing included functionality testing, User Acceptance Testing (UAT) using a five-point Likert scale, and network performance testing. Finally, the Reviewing phase refined system features based on feedback before deployment.

3 Results / Findings

The evaluation of the Bisik Budi application was conducted through functionality testing, User Acceptance Testing (UAT), and network performance testing. Functionality testing confirmed that all defined system modules operated according to the specified requirements. UAT results

from both aphasia patients and caregivers recorded average scores above 4.0 on a five-point Likert scale, indicating high usability, accessibility, and overall satisfaction. Network performance testing further demonstrated that the application maintained stable performance under different connectivity conditions. Overall, the findings indicate that the system is functional, reliable, and well-accepted by its intended users.

4 Novelty of Project / Product / Project

The novelty of Bisik Budi lies in its Malay-centric and culturally localized AAC solution tailored specifically for aphasia patients in Malaysia. Unlike many existing AAC applications designed for Western and English-speaking users, this system addresses language, cultural relevance, and accessibility barriers faced by Malay-speaking elderly users. The application uniquely integrates AAC communication support with structured therapy modules and cloud-based caregiver monitoring within a single mobile platform. This integrated and localized approach provides a more accessible and contextually relevant rehabilitation tool for the Malaysian healthcare environment.

5 Conclusion or Future Work

In conclusion, the Bisik Budi application successfully achieved its objectives as a mobile-based AAC and telerehabilitation tool tailored to the Malaysian context. The system demonstrated functional reliability, positive user acceptance, and stable performance, indicating its potential to support communication and rehabilitation for Malay-speaking individuals with aphasia. Future work may focus on integrating AI-based adaptive therapy, enhancing offline capabilities, and conducting larger-scale clinical evaluations to further validate its effectiveness.

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STUDENTASSIST: A WEB-BASED EXPENSE AND ACTIVITY MANAGEMENT SYSTEM WITH GOOGLE ANALYTICS

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Abstract

The managing daily expenses, academic schedules, and student activities can be challenging for university students due to the lack of a centralized management system. Many students rely on separate applications or manual methods such as notebooks and reminders, which may lead to poor financial tracking and missed academic tasks. This study introduces StudentAssist, a web based expense and activity management system designed to help students organize daily expenses, subject schedules, and upcoming events within a single platform. The system integrates Google Analytics to analyse user interaction and system usage behaviour for future improvements. The development followed the Waterfall methodology consisting of requirement analysis, system design, implementation, testing, and documentation. The system was developed using PHP, MySQL, and a responsive web interface. Testing results show that StudentAssist effectively assists students in managing their academic activities and personal expenses while providing useful analytical insights for system improvement.

Keywords: Expense Management, Student Productivity, Web Application, Google Analytics, Activity Management

1 Introduction

University students often face difficulties managing academic responsibilities and personal finances. Many students struggle to track daily spending, organize subject schedules, and remember important academic activities such as assignments or examinations. The absence of an integrated management platform often results in inefficient planning and financial management. Existing tools such as expense trackers or calendar applications usually focus on a single function and do not provide a complete solution that integrates both financial and academic management. As a result, students must rely on multiple platforms, which may reduce efficiency and increase the risk of missing important information. To address this issue, this project proposes StudentAssist, a web based system that enables students to record expenses, manage subject schedules, and organize events within a single platform. The system also integrates Google Analytics to monitor user activity and provide insights for system improvement. The main objective is to develop a centralized platform that enhances student productivity and financial awareness.

2 Methodology

This study adopted the Waterfall methodology to guide the development of the StudentAssist system. The methodology consists of several phases including requirement analysis, system design, development, testing, and documentation. During the requirement analysis phase, information was gathered through literature review and observation of common problems faced by students when managing expenses and academic activities. In the design phase, system architecture and interface prototypes were developed using UML diagrams. The development phase involved implementing the system using PHP, MySQL database, and Visual Studio Code. The web interface was designed to be responsive and user friendly. Google Analytics was integrated to collect and analyse user interaction data. Testing was conducted through

functionality testing and usability testing. Functionality testing ensured that all modules operate correctly, while usability testing evaluated user satisfaction and ease of use.

3 Results / Findings

The results show that the StudentAssist system operates successfully according to the defined requirements. The system provides several modules including expense management, subject scheduling, event planning, and document access. Functionality testing confirmed that students can record expenses, calculate monthly totals, manage subject timetables, and create reminders for upcoming events. The integrated database ensures efficient data storage and retrieval. Usability evaluation indicates that users find the system interface clear and easy to navigate. Students reported that the system helps them manage academic activities and personal finances more effectively. The integration of Google Analytics also provides useful insights into user interaction and feature usage.

4 Novelty of Project / Product / Project

The novelty of the StudentAssist system lies in the integration of multiple student management features within a single web based platform. Unlike conventional applications that focus only on expense tracking or scheduling, StudentAssist combines financial tracking, academic activity management, and event planning. Another unique aspect is the integration of Google Analytics, which allows developers to monitor user behaviour and system usage patterns. These insights support future system improvements and optimization. The system is specifically designed for university students, ensuring that the features meet their academic and financial management needs.

5 Conclusion or Future Work

In conclusion, the StudentAssist system demonstrates that a web-based management platform can effectively assist students in organizing academic activities and managing personal expenses. The centralized system improves efficiency and helps students maintain better control over their schedules and finances. Future improvements may include mobile application integration, intelligent expense categorization using artificial intelligence, and enhanced data visualization features to provide clearer financial insights for students.

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CHOP!: SPORTS FACILITY RESERVATION MOBILE APPLICATION FOR UITM STUDENTS

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Abstract

MalayThe current system used to run sports facilities in UiTM Perlis is the manual system of managing the facility, including physical logbooks and phones, since it results in duplicated reservations and a lack of transparency. The proposed study will create and test CHOP!, a mobile application that will facilitate the booking process. The application is built on Android Studio and connected to Firebase Realtime Database and offers an opportunity to track real-time availability and navigate it with the help of Google Maps API. The process was designed based on the Waterfall Model to have a well-structured lifecycle of the requirement analysis and system testing. Thirty students were used in the functionality and usability tests. The system passed the functionality test with 100 percent and the grand mean of 1.36 on the 7-point Likert scale, which is the grand mean of the usability, that the users strongly agree with the efficiency of the application. The results of this study indicate that cloud-based mobile solutions can be effectively used to streamline resource management at a university and guarantee that the student experience is maximized.

Keywords: Mobile Reservation System, Firebase Realtime Database, Waterfall Model, UiTM Perlis

1 Introduction

At UiTM Perlis, the manual system of reserving sports facilities causes major obstacles to students, such as the fact that they have to be physically present to find out when they can use a particular facility and a high chance of a conflicting schedule. Digital disparities that exist results in underutilized resources and administrative waste. This project presents CHOP!, which is an Android-based system that will centralize the reservation process. The main targets are to find out what the users need in sport booking, design a working mobile prototype with clouds integration and test its utility among the campus community. Recent studies suggest that just having basic availability isn't enough because facility quality, risk management techniques, and user engagement tactics all need to work together to keep people coming back (Fitri et al., 2022).

2 Methodology

The model applied in the project was the Waterfall Model which has five different stages: Requirements Analysis, System Design, Implementation, Testing and Documentation. In a waterfall model, each phase must be completed before the next phase can begin and there is no overlapping in the phases (Senarath, 2021) In the implementation stage, application logic was done in Java and backend services like authentication and real-time storage were made available by Firebase. It found that Firestore is better at handling large amounts of data or complex queries because it has a scalable architecture and efficient indexing (Kot & Smołka, 2023). The design involved the development of Use Case Diagrams, Class Diagrams, and Sitemaps to make sure that there was a logical flow of users. To be evaluated, the research used the Functionality Testing (Black-box testing) to test 14 core modules and Usability Testing that was founded on the Post-Study System Usability Questionnaire (PSSUQ). The data were

gathered on 30 respondents based on a 7-point likert scale of Information Quality, System Usefulness, and Interface Quality.

3 Results / Findings

The results of the evaluation indicated that the application was effective in dealing with the gaps in the manual system that were identified. The functionality testing showed 100 percent success rate and all features such as the ability to use Google Maps to navigate, real-time updates of court status and workflow of approving the work were fully functional. The Grand Mean score in usability testing was 1.36 with a score of 1 being the maximum level of user satisfaction. In particular, the score of Information Quality was 1.31, System Usefulness was 1.36, and Interface Quality was 1.40. These findings prove that students have considered the app much more efficient than the manual logbook system. Real-time data integration is such that as soon as an admin approves a request, the facility status is updated immediately on all devices of the user, which practically excludes any errors of double-booking.

4 Novelty of Project / Product / Project

The originality of CHOP! is that it is customized locally to the UiTM Perlis ecosystem. This system of booking, unlike generic booking apps, will incorporate particular campus regulations, including student-specific working hours and user access as an administrative member of the university. It exploits the Firebase Push Key reasoning to develop an exclusive synchronization connection between student sorties and bureaucratic interventions that is a sound substitute to solid recordings in the database. In addition, the integration of the location based services through the Google Maps API customized to the coordinates of the campuses courts offers a distinct feature of navigation that joins the digital booking and the actual use of a physical facility.

5 Conclusion or Future Work

The project was able to computerize the sports facility reservation system at UiTM Perlis with a high level of usability and functional reliability. The next steps of work will be aimed at the introduction of Push Notifications as immediate status updates and the extension of the platform to iOS devices. Also, incorporation of a Maintenance Module would enable the user to report issues of the facility, and the app would become a complete resource management tool on campus.

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TONE MASTER: AI-POWERED MANDARIN TONE RECOGNITION MOBILE APPLICATION FOR UiTM STUDENTS

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Abstract

Mandarin courses at Universiti Teknologi MARA (UiTM), specifically TMC451 and TMC501, rely on traditional textbook-based instruction. This method limits student engagement and lacks real-time pronunciation feedback, particularly for mastering Mandarin's four tones. Malay-speaking students face additional difficulty due to Malay being non-tonal. This paper introduces ToneMaster, an AI-powered mobile app designed to assist mastery of the different Mandarin tones through gamification, speech recognition, and adaptive learning. Developed using the Waterfall SDLC, the app integrates Flutter for frontend, Firebase for backend, and TensorFlow Lite for on-device tone analysis. The AI evaluates pitch contours, classifies tones, and provides instant feedback. Gamified features such as EXP points, boss battles, and progress tracking boost motivation. User Acceptance Testing (UAT) and Usability Testing (UT) showed improved engagement, pronunciation confidence, and syllabus alignment. ToneMaster demonstrates that AI and adaptive mobile learning can significantly enhance Mandarin tone acquisition for Malay-speaking students.

Keywords: Mandarin Learning, AI Speech Recognition, Gamification, Adaptive Learning, Mobile Application

1 Introduction

Mandarin is spoken by over one billion people worldwide and is increasingly important in Malaysia due to economic and academic ties with China. UiTM offers Mandarin courses like TMC451 and TMC501 (UiTM, 2023), but instruction remains textbook-based and lecture-driven. This approach fails to engage digital-native students and does not address the tonal nature of Mandarin, especially for Malay speakers whose native language lacks lexical tones (Li & Wang, 2022). Without real-time feedback, learners often develop persistent pronunciation errors. While apps like Duolingo and HelloChinese offer gamification and speech recognition, they are not aligned with UiTM's syllabus nor tailored to Malay-specific difficulties. Thus, a curriculum-aligned, AI-supported tool is needed. This study presents ToneMaster, a mobile application combining gamification, AI-powered tone recognition, and adaptive learning to support Mandarin pronunciation mastery for UiTM students.

2 Methodology

ToneMaster was developed using the Waterfall Software Development Life Cycle (SDLC), comprising five phases:

1. **Requirement Analysis** – A literature review and feasibility study identified gaps in traditional Mandarin learning and evaluated technological solutions.

2. **System Design** – Use case diagrams, flowcharts, and UI wireframes were created. The architecture integrates Flutter (frontend), Firebase (backend), and TensorFlow Lite (AI engine).

3. **Development** – The app was built with Flutter, using Firebase Authentication and Cloud Firestore for user management. A machine learning model trained on pitch contour data was converted to TensorFlow Lite for real-time on-device inference.

4. **Testing** – Functional testing, User Acceptance Testing (UAT), and Usability Testing (UT) were conducted with UiTM Mandarin students.

5. **Documentation** – Final refinements and project reporting were completed.

The AI module extracts pitch-related features to classify Mandarin tones, providing accuracy scores and confidence levels for nuanced feedback.

3 Results / Findings

Testing results showed positive outcomes in usability, engagement, and pronunciation improvement. Students confirmed that the app aligns well with the TMC451 and TMC501 syllabus. Learning effectiveness was enhanced through real-time tone visualization, which improved pitch accuracy awareness. Gamified elements such as EXP points, boss battles, and streak tracking boosted motivation. Users reported clear navigation, responsive performance, and an intuitive interface. The AI tone recognition system successfully detected tonal errors and provided immediate feedback with low latency, supporting meaningful pronunciation practice.

4 Novelty of Project / Product / Project

ToneMaster's novelty lies in its localized, curriculum-aligned design, specifically mapped to UiTM's TMC451 and TMC501 syllabus. It is optimized for Malay-accented Mandarin pronunciation and uniquely integrates gamification with AI-powered tone recognition. The app adapts learning difficulty based on user performance. The combination of lightweight TensorFlow Lite deployment with mobile gamification offers a practical and scalable solution for Mandarin tone training in Malaysian higher education.

5 Conclusion or Future Work

ToneMaster demonstrates that integrating AI, gamification, and adaptive learning into a mobile app can significantly enhance Mandarin tone acquisition for Malay-speaking students. It addresses engagement limitations, pronunciation challenges, and inflexible pacing in traditional methods. Future enhancements may include expanding the pronunciation dataset for better accent recognition, integrating a lecturer monitoring dashboard, and implementing advanced tone sandhi detection for more contextual evaluation. ToneMaster serves as a pedagogically aligned and technologically innovative solution for Mandarin learning at UiTM.

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ECOTRACK: SMART IOT-ENABLED RECYCLING MANAGEMENT MOBILE APPLICATION

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Abstract

Traditional university campus recycling practices are often affected by low student participation, improper waste classification, and limited integration of digital technologies such as mobile and Internet of Things (IoT) applications. These challenges lead to inefficient recycling management and hinder environmental sustainability efforts. This paper presents EcoTrack, a smart IoT-enabled recycling management mobile application developed for the UiTM Arau campus. The system integrates IoT-based smart recycling bins with an Android mobile application featuring waste scanning, QR code verification, and a point-based reward mechanism to encourage proper recycling behaviour. The application was developed using Android Studio and Firebase, while the smart bin prototype utilizes an ESP32 microcontroller with ultrasonic sensors and a servo motor for controlled waste disposal. System evaluation included functionality, network, and usability testing. Results indicate that EcoTrack operates reliably with average response time of 5.13 seconds from QR scan to bin activation, maintains stable data synchronization, and achieves positive usability scores across all evaluation sections (mean scores 3.38-3.98 on 5-point scale). Overall, the integration of IoT and mobile technology demonstrates strong potential to improve recycling participation within a university campus environment.

Keywords: IoT, smart recycling, mobile application, ESP32, gamification

1 Introduction

Malaysia generates approximately 27,000 tons of solid waste daily, with university campuses contributing substantially. At Universiti Teknologi MARA (UiTM) Arau Campus, only ~30% of students actively recycle (Bashir et al., 2020), due to inadequate awareness, inaccessible facilities, and lack of incentives. Existing IoT bin monitoring, AI waste classification, and gamification solutions address these issues in isolation, and none target the Malaysian university context. Studies have shown that smart recycling systems equipped with sensor-enabled bins, AI-based waste recognition, and mobile applications can significantly improve waste sorting accuracy, streamline collection logistics, and foster pro-environmental behavior (Al Mamun et al., 2021). An EcoTrack: Smart IoT-Enabled Recycling Management Mobile Application for UiTM Arau Campus is thus proposed to improve the low recycling participation and negative attitude of university students.

2 Methodology

EcoTrack was developed using the Waterfall SDLC model. The mobile application was built with Flutter (Dart SDK) and Firebase (Realtime Database, Cloud Firestore, Authentication), supporting plastic, paper, and metal categories. Features include QR code bin identification, waste guidance, a point-based reward system, leaderboard, Google Maps bin locator, and admin dashboard. The smart bin prototype uses an ESP32 microcontroller, HC-SR04 ultrasonic sensor (8 cm threshold), and SG90 servo motor. Firmware was programmed in Embedded C++ (Arduino IDE) with hybrid mode operation local sensor-driven when offline, cloud-synced via Wi-Fi otherwise. QR scans trigger lid activation and automatic reward point allocation via Firebase. Evaluation comprised: (1) functionality testing of 10 app features and 9 bin operations; (2) network testing for response time, Wi-Fi vs. hotspot comparison, and recovery

from disconnections; and (3) usability testing with 20 students using a 20-item, 5-point Likert scale questionnaire.

3 Results / Findings

All functionality test cases passed without errors. Average end-to-end response time was 5.13 seconds (QR scan to servo activation); mobile hotspot (4.12 s) outperformed campus Wi-Fi (6.38 s) due to congestion. The system recovered from all three simulated network outages. Usability scores ranged from 3.38–3.98 on a 5-point scale. Highest scores: Compatibility & Performance (3.98), Navigation & Efficiency (3.90), and Interface Design (3.85). Lowest: Information Quality & Clarity (3.38), indicating room to improve recycling guidance content. All sections exceeded the neutral midpoint.

4 Novelty of Project / Product / Project

EcoTrack is the first system to combine IoT smart bins, real-time cloud synchronization, and gamified engagement specifically for Malaysian university campuses. Its hybrid bin operation ensures continuity during outages. The QR-based reward pipeline addresses the three key barriers inconvenience, low awareness, and lack of motivation in a single platform. Firebase and modular bin design enable scalable campus-wide deployment without major infrastructure changes.

5 Conclusion or Future Work

EcoTrack successfully demonstrates that IoT technology combined with gamified mobile application design can improve university recycling participation. The system achieved reliable bin operation, stable cloud synchronization, and positive user acceptance. Future enhancements include: AI-based waste classification, campus-wide multi-bin deployment, advanced analytics (trend analysis, predictive alerts), richer gamification mechanics, and improved network security positioning EcoTrack as a smart campus sustainability solution aligned with UN SDG 11 and SDG 12.

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INTRUSION MONITORING AND DETECTION SYSTEM FOR SMART HOME NETWORK USING RASPBERRY PI

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Abstract

The rapid proliferation of Internet of Things devices has transformed modern households into smart environments, yet these networks often remain vulnerable due to inadequate security measures. This research addresses the critical need for affordable security by developing an Intrusion Monitoring and Detection System specifically designed for smart home networks using a Raspberry Pi 5. The system integrates the Suricata detection engine with the Elastic Stack, comprising Elasticsearch and Kibana, to provide a robust monitoring framework. A key technical feature of this implementation is the use of a passive Out of Path topology via Port Mirroring, which ensures that network traffic is monitored without introducing latency or affecting user connection speeds. The system was rigorously tested against two common network threats which are Denial of Service and ARP Spoofing. Experimental results demonstrate that the system successfully identifies these attacks in real time while visualizing the data on a centralized dashboard. Analysis of the performance metrics revealed that a Denial-of-Service attack caused catastrophic network degradation with latency spikes exceeding 100 seconds, while ARP Spoofing led to a significant and persistent increase in response times. This study proves that a single board computer can effectively host enterprise grade security tools to protect domestic environments. The findings suggest that this low-cost solution provides a viable alternative to expensive proprietary hardware, offering homeowners a high degree of visibility into their network security status without requiring extensive technical expertise or significant financial investment.

Keywords: Intrusion Detection System, Raspberry Pi 5, Suricata, Smart Home Security, ELK Stack

1 Introduction

Smart home networks in Malaysia are increasingly targeted by cyber threats because many IoT devices operate with default configurations and minimal security. Attacks like Denial of Service can disable home automation and compromise privacy. This project proposes an affordable Intrusion Detection System using Raspberry Pi to monitor traffic and detect malicious activity without slowing down the network. By focusing on cost-effective hardware and open-source software, the study aims to provide a practical security framework that empowers domestic users to protect their increasingly connected and vulnerable digital environments.

2 Methodology

The project followed the Waterfall model to ensure structured development and testing. The hardware setup includes a Raspberry Pi 5, a Smart Managed Switch for Port Mirroring, and a 4G LTE Router. The software utilizes Ubuntu Server with Suricata, and the ELK Stack deployed via Docker containers for efficient resource management. Testing involved baseline measurements followed by active attack simulations to evaluate bandwidth, latency, and response time. This systematic approach allowed for a clear comparison between normal network behaviour and the anomalies triggered during simulated cyberattacks.

3 Results / Findings

The system successfully logged and visualized attack signatures through the Kibana interface. During DoS attacks, bandwidth usage spiked by over 500 MB and latency reached 105 seconds, causing network paralysis. ARP Spoofing tests showed response times doubling or tripling, confirming the presence of a man in the middle intercepting data. The ELK dashboard provided clear real time alerts for both scenarios, proving the system's ability to process high volumes of traffic and deliver actionable security insights under extreme stress conditions.

4 Novelty of Project / Product / Project

This project demonstrates the successful integration of a full enterprise security stack on a Raspberry Pi 5 using an Out of Path deployment. This setup ensures zero impact on the primary network performance while maintaining professional grade detection capabilities for home users. Unlike traditional inline systems that can become a single point of failure, this mirror-based approach allows for continuous monitoring without risking the connectivity of the smart devices, providing a unique balance between high level security and network reliability.

5 Conclusion or Future Work

The Raspberry Pi based IDS is an effective and inexpensive solution for smart home security. It successfully identifies complex threats while remaining accessible to average users. Future work will focus on evolving the system into an Intrusion Prevention System to automatically block threats and incorporating machine learning for anomaly detection. Additionally, expanding the system to monitor wireless authentication attacks would provide a more comprehensive security perimeter, ensuring that both wired and wireless components of the smart home are fully protected.

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AN E-COMMERCE PLATFORM WITH ROLE-BASED ACCESS FOR UITM COMMUNITIES

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Abstract

The growing entrepreneurial interest among university students in Malaysia has increased the demand for a proper digital platform for campus-based buying and selling. At the moment, members of the Universiti Teknologi MARA (UiTM) community mostly use WhatsApp and Telegram groups to promote and sell products. These platforms do not support key e-commerce features like product filtering, personal storefronts, inventory tracking, secure payments, and sales analytics. This makes it hard for student merchants to manage their businesses well. To solve this, the project builds MarKet, a secure and campus-focused e-commerce web application made for the UiTM community. The system uses the MERN stack (MongoDB, Express.js, React.js, Node.js) and includes role-based access control, seller storefronts, real-time inventory tracking, and sales dashboards. The project follows a Kanban Agile approach with iterative development and testing throughout. Key features like fuzzy search, product filtering, seller dashboards, and sales analytics are built to fix the problems found in informal campus trading. What makes MarKet different is its focus on the campus setting, where trust and ease of use within a university matter most. Unlike general online marketplaces, it gives students a structured space to buy and sell while building their digital and business skills. The platform is also built to scale and can be adapted for use at other universities.

Keywords: E-Commerce, MERN Stack, Role-Based Access Control, Campus Marketplace, Student Entrepreneurship

1 Introduction

E-commerce has grown rapidly among Malaysian internet users. According to the Malaysian Communications and Multimedia Commission (2022), 66.6% of respondents shopped online, with about 40% in the student age range of 15 to 29 years. Even so, many UiTM community members still use WhatsApp and Telegram to buy and sell on campus. These apps are not designed for trading. Older posts get buried quickly, there is no way to filter or search products properly, and there are no tools to track stock or sales (Bietti & Mayor, 2023; Richardson & Choong, 2023). Payments also happen informally, which puts both buyers and sellers at risk of fraud (Dwight, 2023). This project builds MarKet to replace these informal methods with a proper campus marketplace.

2 Methodology

MarKet was built using the MERN stack for its flexibility and JavaScript-based full-stack development (Bafna, 2022). A Kanban Agile method was used to manage tasks on a visual board with six stages from backlog to done. Features were built in three sprints covering product browsing and cart, payment and merchant tools, and admin management. Security was handled through JWT tokens in HTTP-only cookies, bcrypt password hashing, CSRF protection, and rate limiting (Uddin et al., 2019). The app was deployed on AWS EC2 with S3 for image storage. Testing covered unit tests with Jest, API tests with Postman, security scanning with OWASP ZAP, and usability testing with 32 UiTM users.

3 Results / Findings

Usability testing was done with 32 participants where 93.8% were students. All scores were

above 4.0 out of 5.0. Functional correctness got a mean of 4.48, showing that login, browsing, cart, checkout, orders, and dashboards all worked as expected. Usability and interface design scored 4.43, meaning users found the system easy to navigate. Performance and reliability got the highest score of 4.50, with users confirming fast load times and stable operation. Security and trust scored 4.31, showing users felt safe using the platform. Overall satisfaction scored 4.45 and most respondents said they would use MarKet if it was deployed at their university. Security testing with OWASP ZAP found no high-risk issues. Two medium-risk findings were noted but both have known fixes through Helmet.js and Nginx settings.

4 Novelty of Project

MarKet stands out because it was designed specifically for a campus setting, unlike general platforms like Shopee or Lazada. It uses a three-role access system where consumers, merchants, and admins each see only what is relevant to them (Le et al., 2022). Merchants get tools that are not available on informal channels such as real-time stock tracking, a personal storefront, and a dashboard showing sales data and low stock alerts. The fuzzy search and filtering system makes it easier to find products by category or price. Payments go through Stripe with support for local options like FPX and GrabPay. The platform also supports users with visual impairments and is built to be extended later with features like an AI assistant for merchants.

5 Conclusion and Future Work

MarKet was successfully developed as a campus e-commerce platform that fixes the problems caused by using WhatsApp and Telegram for trading at UiTM. The system offers product browsing, inventory management, Stripe payments, and separate dashboards for merchants and admins. Usability testing gave an overall mean of 4.45 out of 5.0 and security testing found no high-risk vulnerabilities, showing the system is ready for real use. The current limitations are that Stripe Connect Express is not fully available in Malaysia and the platform only covers one campus so far. Future plans include adding an AI assistant for merchants, supporting multiple campuses, and testing local payment options.

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AZCSALES: MULTI-BRANCH CAFÉ SALES MONITORING SYSTEM WITH ROLE-BASED ANALYTICS DASHBOARD

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Abstract

Malaysian Food and Beverage (F&B) Small and Medium Enterprises (SMEs) often face inefficiencies in their operations during record-keeping because of manual records. This essay outlines AZCSALES, an integrated web-based sales monitoring program that can be applied in a multi-branch cafe setup, in this case, to deal with data duplication and lack of financial transparency. The system, developed with the Waterfall Methodology, employs the use of Laravel 11 and PostgreSQL in offering Role-Based Access Control (RBAC), automated inventory deduction, and consolidated reporting. The Technology Acceptance Model (TAM) was used to evaluate the systems with seven stakeholders. The findings showed a high degree of acceptance as the mean score of Perceived Usefulness (PU) was 4.74 and Attitude Towards Using (ATU) was 4.90. The results attest to the efficiency of the AZCSALES in terms of replacement of manual operations, which were obsolete and lacked accountability of data and operational efficiency in various sites.

Keywords: Sales Monitoring, Multi-branch Management, Laravel, Role-Based Access Control, TAM.

1 Introduction

F&B is an important part of the Malaysian economy, but most SMEs face low profit margins of between 3-5 percent (Zubir et al., 2023). Multi-branch operation relies on manual spreadsheets which causes discrepancies and decision-making delays. Initial examination of the case study, Arissazana Enterprise, revealed three important problems: lack of transparency in Cost of Goods Sold (COGS), the inability to categorize the losses because of not efficient use of stock, and no validated audit trail. Small businesses that needed the precision of financial data in competitive markets had to upgrade their systems to automated ones (Abbasi et al., 2022). AZCSALES fills those holes by providing a live performance perspective. The system guarantees data integrity due to the multi-tier verification workflow, where input data must undergo auditing by the managers before complete approval.

2 Methodology

AZCSALES was developed using the Waterfall Model, which includes planning, analysis, design, development, and documentation. The stakeholders were involved in setting system requirements that outlined individual responsibilities of the HQ Administrator, Branch Managers, and Staff. The design stage was based on Draw.io and Canva used to map their interaction flows of the UI/UX and database logic. Its implementation was based on a modern and scalable technology stack with a Laravel 11 backend and a Model-View-Controller (MVC) architecture. PostgreSQL was chosen because it is an ACID-compliant database to coordinate concurrent multi-branch transactions. The frontend was developed with a hybrid of Blade Templating, Bootstrap 5, and Tailwind CSS to identify device responsiveness with Chart.js to give real-time analytics. Modularity and security ensured by structuring the architecture in five autonomous layers Presentation, Application, Business Logic, Data Access, and Database.

3 Results / Findings

The functionality of the system was verified using a User Acceptance Test (UAT) on the Technology Acceptance Model (TAM) framework (Davis, 1989). Quantitative findings revealed a high level of acceptance of all constructs. Perceived Usefulness (PU) had a mean of 4.74, which confirms the effectiveness of the system in sales monitoring. Perceived Ease of Use (PEOU) was 4.51, indicating that the interface is consumer-friendly with slight suggestions regarding role-switching navigation. Attitude Towards Using (ATU) also showed the best score of 4.90, which represents a very positive perspective towards productivity gains. Lastly, Behavioural Intention to Use (BIU) score of 4.75 assured a high level of stakeholder commitment towards long-term implementation.

4 Novelty of Project / Product / Project

AZCSALES is innovative in the sense that it incorporates a Sales Report Verification Workflow and a specific Batch Handling and Expiry module. It also uses hierarchical Role-Based Access Control (RBAC) to implement two-level authentication, unlike generic point-of-sale systems (Sandhu et al., 2000). Records cannot be tampered with as the sales data are still in a state of Pending awaiting audit by a manager. Moreover, the system also calculates the perishable goods expiration dates automatically on entry and provides real-time "Critical" inventory warnings. This proactive approach not only avoids selling spoilt products but also records "invisible" monetary losses previously unrecorded in manual spreadsheets, which would give the stakeholder some form of financial intelligence it never had previously.

5 Conclusion or Future Work

To sum up, the AZCSALES system manages to remove the inefficiencies of manual record-keeping by creating a strong and centralized monitoring environment. The favourable TAM analysis validates the system as a legit substitute to the outdated workflows at Arissazana Enterprise. The direction of the future work is the enhancement of the depth of analytical capabilities with multi-faceted filtering and stackable criteria, including specific time-block analysis. Furthermore, the next round will be more mobile-friendly and will introduce the ability to export data in CSV and Excel formats allowing further customization in third-party accounting software.

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SMARTSPOIL: FOOD WASTE MARKETPLACE MOBILE APPLICATION WITH AI-BASED EXPIRY DATE PREDICTION FOR TEMPEH

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Abstract

Food waste is a significant environmental issue in Malaysia, with approximately 17,000 tonnes generated daily and nearly 4,000 tonnes still edible. Perishable foods such as tempeh are often discarded due to uncertainty about freshness and expiry conditions. Existing food-sharing platforms facilitate food redistribution but lack intelligent systems for automated freshness prediction. This paper presents SMARTSPOIL, a mobile food marketplace application integrated with Artificial Intelligence (AI) to predict tempeh freshness using image recognition. The system was developed using Flutter and integrates Google Gemini AI for image analysis, Firebase for authentication and database management, Stripe API for payment processing, and Google Maps API for vendor location services. System validation involved functionality testing and usability evaluation with 25 respondents. The AI model achieved 87.5% accuracy in freshness classification. Usability results showed mean scores above 4.0 out of 5.0 across all evaluation categories. The results demonstrate that SMARTSPOIL provides a practical AI-driven solution to support food waste reduction while assisting consumers and vendors in making informed decisions regarding food freshness.

Keywords: Artificial Intelligence, Food Waste, Marketplace

1 Introduction

Food waste has become a major sustainability challenge in Malaysia. Approximately 17,000 tonnes of food waste are generated daily, contributing to landfill accumulation and greenhouse gas emissions (SWCorp, 2022). A considerable portion of this waste consists of edible food discarded due to uncertainty about freshness. Tempeh, a fermented soybean product widely consumed in Southeast Asia, has a short shelf life of approximately two to three days at room temperature (Nout & Kiers, 2005). Consumers typically rely on subjective visual inspection to determine freshness, which may lead to premature disposal of still-edible food. Existing food redistribution platforms such as ReMeal and OLIO enable surplus food sharing but do not provide automated freshness prediction. Artificial Intelligence (AI), particularly image recognition, has shown potential in food quality classification (Kaur & Kaur, 2022). Therefore, this study proposes SMARTSPOIL, an AI-powered mobile application that predicts tempeh freshness using image analysis while providing a digital marketplace to support sustainable food consumption.

2 Methodology

The development of SMARTSPOIL followed the Software Development Life Cycle (SDLC) using the Waterfall model, which consists of requirement analysis, system design, implementation, and testing phases. The application was developed using Flutter to enable mobile application development with a single codebase. Firebase Authentication was implemented to manage user registration and login processes, while Firestore database was used to store product data, user information, and transaction records. Artificial Intelligence functionality was implemented using Google Gemini AI for image-based freshness prediction.

Users capture an image of tempeh using the mobile device camera, and the image is converted into byte format before being transmitted to the Gemini API. The AI model analyses visual characteristics such as colour, texture, and fermentation patterns to classify freshness levels and generate a confidence score. Stripe API was integrated to support secure payment transactions within the marketplace system. Additionally, Google Maps API enables users to locate nearby vendors selling tempeh products. System evaluation consisted of functionality testing and usability testing. Usability evaluation involved 25 respondents who assessed the system using a five-point Likert scale questionnaire.

3 Results / Findings

Functionality testing confirmed that all major system modules operated successfully, including user authentication, AI-based freshness prediction, marketplace browsing, cart management, payment processing, and vendor inventory management. The integration of Google Gemini AI achieved 87.5% accuracy in classifying tempeh freshness when compared with expert validation. Usability testing results indicated strong user acceptance across several evaluation criteria. The mean scores obtained were 4.5 for user interaction, 4.4 for compatibility, 4.3 for interface design, 4.2 for information clarity, and 4.0 for navigation. These findings indicate that SMARTSPOIL provides reliable system performance, positive user experience, and practical applicability for supporting food waste reduction initiatives.

4 Novelty of Project / Product / Project

The novelty of SMARTSPOIL lies in integrating AI-based image recognition technology with a localized food marketplace platform. Unlike existing food redistribution applications, SMARTSPOIL provides automated freshness prediction using image analysis to assist users in determining the quality of tempeh. Furthermore, the system combines food waste reduction strategies with marketplace functionality, enabling consumers and vendors to participate in sustainable food trading practices. This approach contributes to innovative technological solutions for food waste management within the Malaysian context.

5 Conclusion or Future Work

In conclusion, SMARTSPOIL demonstrates that AI-based image recognition can effectively support food waste reduction by providing objective freshness prediction for tempeh. The system achieved strong usability scores and reliable prediction accuracy. Future work may involve expanding the AI model to support additional food categories, improving prediction accuracy through larger datasets, and implementing on-device machine learning to enhance prediction speed and efficiency.

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PULSEMIND: INTELLIGENT MOBILE APPLICATION FOR REAL-TIME STRESS DETECTION AND RELIEF

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Abstract

Academic pressure, work pressure, and personal problems have majorly contributed to stress among students and working adults as a significant mental health issue. The majority of the current applications in stress management offer static information like meditation tracks and relaxation practices without real-time tracking and feedback. The paper is a description of PulseMind, an intelligent mobile app that can recognize and deal with stress based on an analysis of facial expressions and a questionnaire-based test. Appropriate Flutter is used in Android Studio to develop the application and Firebase is integrated to provide authentication and data storage services. On device facial detection is done using Google ML Kit and it is used to estimate stress levels by using facial features. Depending on the level of stress identified, the system will give individual recommendations such as relaxing music, simple nutrition facts, and stress trend visualization in graphs after every month. Rapid Application Development (RAD) methodology was used to allow an iterative approach to prototyping and constant user feedback. The testing was performed, and the performance of the system and the satisfaction of the users were evaluated through functional and usability testing. These results point to the fact that PulseMind leads to more awareness among users regarding their stress patterns and responsive and user- centered stress management support. The adoption of artificial intelligence methods within a mobile platform proves to have a high potential to enhance the availability of accessible digital mental health solutions.

Keywords: Stress Detection, Mobile Application, Artificial Intelligence, Facial Recognition, Mental Health

1 Introduction

Stress is an emotional and physical reaction to stressing circumstances. In its unmanaged form, long term stress may cause anxiety and depression as well as low productivity. Academic requirements and employment strains are some of the causes of stress experienced by students and working adults in Malaysia. Even though there are different applications in mental wellness, most of them do not adjust to the real-time emotional status of the users. The currently available applications focus on providing general meditation material, but not dynamically detecting stress. This weakness explains why a smart and dynamic stress management model that is capable of incorporating real-time monitoring and customized support is required.

2 Methodology

The methodology used in this project is Rapid Application Development (RAD) that has the following steps: Requirement Planning, User Design, Construction, and Cutover. Google survey was also used to determine user preferences and stress management requirements through a preliminary survey conducted with the help of a Google form. During the design phase, system models like prototypes, flowcharts and use case diagrams were created. Flutter and Dart were used in Android Studio to construct the application. Google ml Kit was incorporated in detecting facial expressions, Firebase Authentication and Firestore were used to manage secure data. Reliability and user satisfaction were checked by means of functional and usability testing.

3 Results / Findings

Operational testing was also successful as all the key modules such as user authentication, facial detection, stress questionnaire, calming music playback, and stress graph visualization worked with success. The usability test showed good feedback of interface clarity, ease of navigation and usefulness. According to the users they could now better monitor their stress levels with graphical tracking and specific recommendations. The hybrid system of face analysis and questionnaires was more reliable than one-method systems.

4 Novelty of Project / Product / Project

The innovation of PulseMind is the hybrid nature of the mechanism of detecting stress which combines the analysis of facial expression with a questionnaire-based method in one mobile platform. In contrast to traditional stress management applications, which use only the content of the meditations or manual mood tracking, PulseMind uses the artificial intelligence methods to track stress in real-time (nearly). Its adaptive and user-friendly design is also supported by the provision of customized recommendations and visualization of stress trend.

5 Conclusion or Future Work

To sum up, the article PulseMind shows that artificial intelligence and mobile technology are successfully incorporated to detect and control stress intelligently. The system increases emotional awareness and offers easy coping strategies to the users. The future work can involve the incorporation of voice stress detection, the expansion of biometric analysis, and the large-scale user studies to confirm the effectiveness in the long term. There is high potential of the application becoming a full scale digital mental health support platform.

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SPENDEX: AN EXPENSE MANAGEMENT APP WITH PERSUASIVE DESIGN FOR ADULTS' FINANCIAL WELLNESS WITH AI CHATBOX

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Abstract

In the current digital economy, many Malaysian adults lack the structured tools and motivational guidance necessary to manage personal finances effectively. Conventional tracking methods are often perceived as tedious, leading to inconsistent budgeting habits and financial stress. SpendEx addresses this gap by integrating persuasive technology and a Generative AI chatbot into a mobile expense management framework. By transforming passive data entry into an interactive experience, the application aims to bridge the transition from awareness to long-term financial discipline.

Keywords: Chatbot, Finances, Persuasive

1 Introduction

In the current Malaysian digital landscape, many adults face significant challenges in financial management due to a lack of structured tools and consistent motivational guidance. Traditional manual expense tracking is often perceived as tedious, leading to low user retention and a persistent gap between financial awareness and actual budgeting discipline. SpendEx is a mobile application developed to address these issues by integrating the 50/30/20 budgeting rule with persuasive technology. By leveraging an AI-powered chatbot, the system transforms raw spending data into actionable insights, aiming to foster long-term financial wellness and proactive budgeting habits among Malaysian users.

2 Methodology

This study employed the Agile Software Development Life Cycle (SDLC), facilitating an iterative process of requirement analysis, design, and testing. The application was built using the Flutter framework for cross-platform performance and Firebase for real-time data persistence and authentication. The core "Financial Coach" was implemented by integrating the Google Gemini AI API, allowing for natural language processing of user queries. System logic was modeled using UML diagrams, and the final product was evaluated through a Technology Acceptance Model (TAM) survey with 30 participants to measure usability and perceived usefulness.

3 Results / Findings

The findings of this study demonstrate high user acceptance of the SpendEx model, with an overall mean score of 4.4. Specifically, the Perceived Ease of Use (PEOU) achieved a high score of 4.66, indicating that the Flutter-based interface is intuitive for the target demographic. Perceived Usefulness (PU) scored 4.41, while Behavioral Intention (BI) 4.29. A specialized open-ended question for the AI Feature Quality (FQ) have score of 4.18. These results confirm that users find the AI-driven financial advice reliable and are highly likely to adopt the application for daily financial management.

4 Novelty of Project / Product / Project

The novelty of SpendEx lies in its hybrid approach to personal finance, moving beyond passive data logging to active behavioral intervention. Unlike traditional banking apps, it utilizes Generative AI as a "Social Actor" to provide real-time encouragement and personalized nudges based on the 50/30/20 framework. The integration of persuasive principles, such as tunneling, reduction, and suggestion, within a chatbot interface represents a unique advancement in financial tools, making the complex task of budgeting both accessible and engaging for non-expert users.

5 Conclusion or Future Work

In general, the developed application successfully meets its objectives of providing a functional, AI-enhanced platform for financial tracking. The high TAM scores validate that the synergy of persuasive design and intelligent automation effectively supports user financial discipline. Future work will focus on expanding the application's capabilities by including multilingual support (Bahasa Melayu and Mandarin) to reach a broader Malaysian demographic and implementing biometric security features to further enhance data privacy and user trust.

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ONLINE GAME-BASED EDUCATIONAL PLATFORM FOR PROGRAMMING

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Abstract

Online Game-Based Educational Platform for Programming is a web-based application for novices and experienced users to learn programming languages with the help of gamification features. The purpose of developing this web application is to assist users to learn programming languages such as C++, JavaScript and PHP through gamification features such as achievements, game-like user interface, daily challenges and leaderboards. Online Game-Based Educational Platform for Programming is containerised for sandbox system, allowing users to write their own code snippets and run it. This web application uses Waterfall Model which consist of 5 phases that are the analysis, design, implementation, testing and maintenance as the methodology. The web was developed using Laravel, phpMyAdmin and Docker. Functionality testing was conducted through nine test cases to verify that all the functions in this web-based application run efficiently and the results was successfully. Usability testing was carried out to 31 participants assessing criteria such as consistency, clarity, feedback, navigation, error handling, satisfaction, efficiency and management. Positive results showed high levels of user satisfaction, with mean scores exceeding 4.0 in all criteria. Future improvements including adding audio feedback beside visual feedback and adding neutral colours to the User Interface design, as well as adding more content and explanation on the web application. In conclusion, this web application offers a method for users to learn programming languages with gamification features as assistance.

Keywords: Game-based Educational Platform, Programming Education, Sandbox System, Web-based System, Waterfall Model

1 Introduction

Gamification, or gameful design, refers to the strategic application of game design principles, mechanics, and elements into non-game environments. It is often used in digital platforms to solve problems, increase interaction between users and their devices, and motivate people towards their goals (Christopoulos & Mystakidis, 2023). Although learning programming is beneficial for higher education, learners tend to have difficulty in blended learning environment and demotivation due to effort and influence (Yong & Tiong, 2022; Wolz et al., 2022). Therefore, this Online Game-Based Educational Platform for Programming aims to help users in adapting and improve results in programming expertise by integrating programming education with the support of game-based elements. This project targets novices or any individuals who wants to learn programming through an engaging and friendly web-based environment.

2 Methodology

This study uses System Development Life Cycle to plan and implement methods to assist with developing of the Online Game-Based Educational Platform for Programming. The Waterfall Model consists of 5 phases which are requirement analysis, design, implementation, testing, and maintenance. The analysis phase is a phase to identify the problem statement, objective, scope, and significance as well as reviewing literature. The design phase focused on designing the sitemap, flowchart, ERD and user interface samples, using the methods found in the analysis phase. In the development phase, the web application is built using Laravel with MySQL as the database management system. The testing phase included functionality testing

through nine test cases and usability testing with 31 participants using structured questionnaires to ensure system's efficiency and user satisfaction. Maintenance phase is done by improving the web application however it is used as documentation as all objectives are achieved in the testing phase.

3 Results / Findings

The Online Game-Based Educational Platform for Programming was evaluated through functionality testing and usability testing. The functionality testing consists of 9 test cases and all test cases passed showing that the web application is able to operate smoothly. Besides that, the web application was given access to 31 respondents to evaluate the web application's usability in terms of consistency, clarity, feedback, navigation, error handling, satisfaction, efficiency, and usability. The total mean scores for all categories exceeding 4.00 indicating a high level of satisfaction from the participants.

4 Novelty of Project / Product / Project

This study introduces a novel approach to game-based educational platform by integrating game-based elements as well as unique settings and containerised for sandbox system. Aside from regular programming education web application, Online Game-based Education Platform for Programming offers friendly gamification features such as progress bar, experience point collection, achievement and daily challenge while adding a minor competitive feature which is the leaderboards. The containerised system which is use for the sandbox system allows users to run their own code snippet creation. These features improve the development of user's programming experience and coding skill.

5 Conclusion

Online Game-based Education Platform for Programming project was developed to assist any users learning programming languages with the help of gamification features. This project enhances the learning efficiency as well as cognitive skills through daily exercises and creating code snippets through examples and creativity. For future work, more enhancements can be made by improving the web application's user interface with neutral colour schemes and audio feedbacks. Furthermore, the web application should offer more content and explanations on the context of the lessons, allowing users to have deep understanding of the core concepts in computer programming.

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SMART GATE LOCK USING VOICE RECOGNITION TECHNOLOGY SYSTEM

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Abstract

The Voice-Activated Smart Locking System addresses security vulnerabilities in traditional locks by utilizing biometric voice authentication. This research integrates an Arduino Uno for local processing and an ESP32 for IoT connectivity to a MySQL database. Results demonstrate high accuracy in voice recognition with less than two seconds of latency between command and actuation. The system effectively provides a keyless security solution with remote monitoring capabilities.

Keywords: Biometric, Voice Recognition, Smart Home System

1 Introduction

Traditional physical keys are prone to loss and unauthorized duplication, creating significant security risks for homeowners and businesses. According to Tullah et al., (2021), conventional keys are insecure and inconvenient due to loss, duplication risks and inefficiency. This project introduces a biometric solution that uses unique vocal characteristics to manage access, eliminating the need for physical keys. By leveraging Internet of Things (IoT) technology, the system enables users to monitor lock status and access logs in real-time via a web-based dashboard. This flexible solution, which meets both residential and commercial applications, places a high priority on user ease and strong protection (Khan & Yusop, 2023).

2 Methodology

The system architecture utilizes a dual-microcontroller design to separate local hardware actuation from cloud-based data logging. An Arduino Uno acts as the central hub, connected to an Elechouse Voice Recognition Module V3 and a 12V relay that controls the solenoid lock. When a voice command is verified, the Arduino triggers the solenoid and simultaneously transmits the event via serial communication to an ESP32. The ESP32 serves as the gateway to the IoT infrastructure, uploading the "Lock/Unlock" status to a MySQL database using a PHP-based API.

3 Results / Findings

Testing confirmed that the system is highly responsive, with the solenoid retracting instantly upon successful voice identification. The Voice Recognition Module V3 performed most reliably with multi-syllabic phrases, which reduced the rate of false negatives compared to short, single-syllable words. The web dashboard accurately displayed real-time logs from the MySQL database, confirming that the serial bridge between the Arduino and ESP32 functioned without data loss. System stability was further ensured by implementing a common ground to prevent electrical noise from the 12V solenoid circuit.

4 Novelty of Project / Product / Project

The novelty of this project lies in the seamless integration of high-accuracy biometric voice recognition with a lightweight IoT monitoring framework. Unlike standard smart locks that

rely on Bluetooth or physical PIN codes, this system provides a hands-free biometric interface coupled with a cloud-based logging system accessible from any web-connected device. The use of a dual-controller setup ensures that security processing on the Arduino is never interrupted by networking tasks on the ESP32, providing a more robust real-time response.

5 Conclusion or Future Work

This project successfully developed an IoT-enabled smart locking system that enhances security through voice authentication. The combination of Arduino and ESP32 provides a reliable platform for both local hardware control and remote data monitoring. Future work will focus on integrating advanced noise-reduction algorithms and developing a dedicated mobile application to further refine user experience and accessibility.

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READRADAR: A WEB-BASED E-BOOK PLATFORM WITH SELF-PUBLISHING FEATURE

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Abstract

The rapid growth of digital reading platforms has expanded access to e-books globally, yet persistent challenges such as fragmented platform, paywalls, limited self-publishing control, and copyright infringement continue to obstruct ease of content sharing. This project developed ReadRadar, a web-based e-book platform designed to address these gaps by providing free, centralised access to research and educational materials while allowing authors with a structured self-publishing environment. Developed using Laravel, PostgreSQL, Tailwind CSS, and Alpine.js., ReadRadar incorporates features such as PDF document upload, online workspace for writing book, user library management, reporting mechanisms, and an administrative dashboard. Evaluations through functionality testing, network performance testing, and usability testing demonstrated that the system operates reliably, performs efficiently, and achieves high user satisfaction, with total mean usability scores consistently above 4.30 across all measured categories. Future improvements include automated plagiarism detection, offline reading support, mobile application development, and further scalability improvements. Overall, ReadRadar contributes a paywall-free, digital reading solution suitable for both academic and leisure contexts.

Keywords: E-Book Platform, Self-Publishing, Digital Reading, Web-Based Application, PDF Document Upload

1 Introduction

Web applications have become essential to daily life, enabling information access, communication, and education at an unprecedented scale (Nyabuto et al., 2024). The growing demand for digital reading materials, particularly among students and researchers, shows the need for reliable and accessible e-book platforms. Studies indicate that e-books offer significant advantages over printed materials including cost efficiency, portability, and multimedia integration, yet realising these benefits depends on the platform's usability and openness (Masa'deh et al., 2022). ReadRadar was developed to bridge this gap by offering a centralised, paywall-free platform that enables users to freely access both academic and leisure materials while enabling authors to publish and manage their content with full control, supported by a secure environment.

2 Methodology

ReadRadar followed the Waterfall methodology, a sequential software development approach comprising four structured phases: Analysis, Design, Implementation, and Testing. During Analysis phase, related data was collected and studied from eligible sources such as journals and conference paper. The Design phase produced an ERD, sitemap, flowcharts, and a PostgreSQL database schema. Implementation used Laravel as the back-end framework with Blade templating, Tailwind CSS, and Alpine.js for the front-end, integrated with Google OAuth, Resend email service, Cloudflare, and DigitalOcean hosting. Testing covered functionality, network performance, and usability evaluation with 40 participants across six categories.

3 Results / Findings

The evaluation of ReadRadar produced consistently positive results across all testing categories. Functionality testing through thirteen test cases confirmed that all core system features passed successfully with no critical failures identified. Network performance testing demonstrated that the platform responded reliably under normal load conditions, with acceptable latency and throughput. Usability testing across all six categoriess which are Consistency, Clarity, Feedback, Navigation, and Efficiency all recorded high mean scores above 4.30 with the overall Satisfaction category indicated that the majority of users were highly satisfied with the platform's interface and functionality. These findings confirm that ReadRadar meets both its technical performance benchmarks and user experience expectations, validating the design and implementation decisions made throughout the project.

4 Novelty of Project / Product / Project

ReadRadar uniquely combines free content access and structured self-publishing in a single open-access platform, unlike commercial alternatives that enforce paywalls or restrict author control. It supports dual publishing options, PDF document upload and an in-platform book writing workspace because PDF is the most used format for digital contents (Vasilakis et al., 2023). A comprehensive admin layer handles user management, content reporting, and automated email notifications for account actions, directly addressing copyright and responsible publishing concerns. Deployed on DigitalOcean with Cloudflare security and Google OAuth integration, ReadRadar is a production-ready, scalable solution.

5 Conclusion or Future Work

ReadRadar successfully addresses the limitations of existing e-book platforms by delivering a reliable, usable, and functional web application for both readers and authors. Usability scores consistently exceeded 4.30 across all categories, confirming strong user acceptance. The project contributes a meaningful open-access solution for digital reading in academic and recreational contexts. In the future, improvement such as automated plagiarism detection, offline reading support, mobile application development, and scalability improvements can be implemented to further enhance the system.

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EMOTIA: HANDLING ANXIETY WITH GAMIFIED WEB APPLICATION FOR UNIVERSITY STUDENTS

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Abstract

University students in Malaysia face a growing mental health crisis, with a 66.2% prevalence rate of moderate to severe anxiety. Despite this, existing interventions often suffer from poor engagement, limited accessibility, and lack of personalisation. This paper presents Emotia, a gamified web application designed to support anxiety management among university students through evidence-based therapeutic techniques and engaging gamification elements. Developed using the Laravel PHP framework, Firebase Authentication, and MySQL database, Emotia incorporates features such as GAD-7 anxiety assessment, guided breathing exercises, daily mood tracking with streak monitoring, activity completion across emotional, physical, and mindfulness categories, and a flower blooming visualisation for wellness progress. Gamification mechanics including experience points (XP), tiered achievement badges, and a redeemable rewards store are integrated to motivate sustained engagement. The application was developed following Agile methodology across five structured phases. Evaluation was conducted using the Technology Acceptance Model (TAM) with 30 university student participants, measuring Perceived Usefulness, Perceived Ease of Use, Attitude Towards Use, and Behavioural Intention. Results demonstrated high user satisfaction, with mean scores ranging from 4.47 to 4.49 across all TAM dimensions, confirming strong alignment with therapeutic objectives and user acceptance goals.

Keywords: Gamification, Anxiety Management, Mental Health, Web Application, University Students

1 Introduction

Mental health disorders, particularly anxiety, affect 66.2% of Malaysian university students at moderate to severe levels, worsened by a 25% global rise since the COVID-19 pandemic (WHO, 2022). Many students avoid professional help due to stigma, financial barriers, and limited access (Kotera & Ting, 2021). Digital interventions offer a scalable, non-judgmental alternative, and gamification has shown strong potential in increasing engagement with mental health activities (Ibrahim et al., 2021). However, existing apps lack comprehensive gamification, personalisation, and evidence-based foundations. Emotia addresses these gaps by integrating Cognitive Behavioural Therapy (CBT) principles and mindfulness practices with meaningful gamification mechanics tailored for Malaysian university students.

2 Methodology

This project adopted Agile methodology across five phases: Planning, Design, Development, Testing, and Documentation. Requirements were gathered through literature review, while UI mockups were designed using Figma. Development used the Laravel PHP framework with Blade templating and Eloquent ORM, Firebase Authentication for secure login including Google Sign-In, and MySQL as the relational database. Evaluation comprised two stages: functionality testing by a professional software developer from Bizsmart Technology Sdn. Bhd., and user acceptance testing using the Technology Acceptance Model (TAM) with 30 university students, measuring Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Attitude Towards Use (ATU), and Behavioural Intention (BI).

3 Results / Findings

Functionality testing confirmed that all core modules, including user authentication, mood logging, XP calculation, anxiety assessment, breathing exercises, and reward redemption, operated correctly and reliably. The expert tester, Falah Zubir, from Bizsmart Technology Sdn. Bhd. rated each module as "Good" and provided improvement recommendations regarding mobile responsiveness and automatic daily login incentives, both of which were subsequently addressed. User acceptance testing yielded consistently high TAM scores across 30 participants. Perceived Usefulness mean scores ranged from 4.43 to 4.53, with mood tracking and overall usefulness scoring highest (4.53). Perceived Ease of Use, Attitude Towards Use, and Behavioural Intention all returned mean scores between 4.47 and 4.49, indicating strong user confidence, positive attitudes, and intention to continue using the application. These results demonstrate that Emotia effectively meets its therapeutic objectives while maintaining high usability standards.

4 Novelty of Project / Product / Project

Emotia distinguishes itself by holistically integrating gamification with evidence-based therapy in a single web platform. Unlike standalone apps, Emotia combines GAD-7 clinical anxiety assessment, three categories of therapeutic activities (emotional, physical, mindfulness), guided breathing exercises with animations, and a flower blooming wellness visualisation. Its gamification system features four badge tiers (bronze, silver, gold, platinum), an XP-based levelling system, and a rewards store for premium features such as Dark Mode and Custom Activity Creator. An admin panel for monitoring user statistics and exporting CSV analytics further adds operational value, making Emotia a novel digital mental health solution for the Southeast Asian context.

5 Conclusion or Future Work

Emotia successfully addressed all three project objectives: identifying system requirements through literature review, developing a fully functional gamified web application, and validating its effectiveness through structured evaluation. High TAM scores (4.47–4.49) confirm strong user acceptance, usability, and intention to continue engagement. Future work will incorporate AI-powered personalised recommendations, peer community features, expanded activity libraries, and improved mobile responsiveness.

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AIOT – BASED SMART AUTOMATION PEST CLASSIFICATION SYSTEM

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Abstract

Agricultural losses due to pests' range between 20% and 40% every year. Manual classification is tedious and inaccurate and is not suitable for early detection. This work proposes a Smart Automation Pest Classification System using AIoT technology for real-time monitoring and classification of pests. The system integrates IoT devices with machine learning for accurate detection and classification. The proposed system employs a dual ESP32 module: one is the ESP32 Dev Kit with a DHT22 sensor, and the second is the ESP32-CAM for automatic image acquisition using a trap. The devices are interconnected via ESP-NOW protocol and send HTTP POST requests to a Laravel React web application. For classification, a YOLOv11 Nano network is used with 102 species trained on IP102. The proposed system employs two AI models for validation: GPT-4.0 for low-confidence detection using n8n. The proposed system's functionality, network, and system tests confirm that it works accurately in autonomous mode and achieves 78.3% mAP@0.5 for detection and 91.3% for top 1 accuracy, which is above 70%. Experts in AI/ML and entomology have validated that the proposed system correctly identifies species, collects environmental data, and generates datasets. The proposed system has high potential for precision agriculture due to early detection, accurate pesticide use, and large datasets. Future work includes training models for different regions, using high-resolution cameras, and crop monitoring.

Keywords: AIoT, pest classification, YOLOv11, Internet of Things, precision agriculture

1 Introduction

The infestation of pests is a global problem that impacts agriculture to the tune of 20-40% of annual crop losses (Gula, 2024). The traditional method of pest monitoring is based on expert-level morphology, which is labor-intensive, error-prone, and not suitable for early-scale detection (Kariyanna & Sowjanya, 2024). The absence of local pest databases is preventing ML model development and IPM (Zheng et al., 2024). The integration of IoT technology with ML has addressed this problem to some extent. The IoT technology helps in collecting remote data in real-time, whereas ML models like YOLO have shown good accuracy in pest detection under field constraints (Ahmed et al., 2024). This paper proposes an AIoT-based Smart Automation Pest Classification System that integrates IoT technology with ML to automate pest trap monitoring and classification with dataset generation.

2 Methodology

This study employed an iterative methodology across five phases: planning, design, testing, analysis, and documentation. The hardware comprises dual ESP32 microcontrollers, an ESP32 Dev Kit transmitting DHT22 sensor data via ESP-NOW to an ESP32-CAM in a modified pest trap, which captures images every five minutes and forwards data via HTTPS POST to a Laravel–React web application. The machine learning pipeline uses two YOLOv11 Nano models trained on the IP102 dataset: a detection model localises pests, and a classification model identifies 102 species. An n8n workflow routes low-confidence detections to GPT-4.0 for dual-AI validation, ensuring >70% accuracy. The system underwent field testing at UiTM Arau starfruit plantation and evaluation through functionality, network, and system testing using TAM, and experts review.

3 Results / Findings

The findings of this study show that all hardware components passed functionality testing, with the DHT22 sensor achieving ±0.1% RH humidity and ±0.3°C temperature accuracy, the ESP32 Dev Kit maintaining 100% uptime with 200 ms ESP-NOW latency, and the ESP32-CAM achieving 95% HTTP POST success. Network testing confirmed 12.40 ms average data transfer time, demonstrating near-real-time performance. The YOLOv11 detection model achieved 78.3% mAP@0.5 with 12 ms inference, while the classification model attained 91.3% top 1 accuracy (97.8% top 5) at 5.8 MB. System testing confirmed the ML model exceeded the 70% accuracy threshold, with data stored in MySQL and exportable as CSV. Independent expert reviews validated system reliability for precision agriculture.

4 Novelty of Project / Product / Project

The system uniquely integrates a dual-microcontroller IoT architecture with a two-stage YOLOv11 Nano, which has not been reported in previous studies. While other systems were designed to detect only one type of pest using single-stage models, the proposed system can classify 102 different pest species, generating an annotated dataset with images, bounding boxes, confidence, and environmental information. The system fills the gap in localised datasets by continuously collecting data in the field with export to CSV, which can be used to train models for specific regions or conduct entomological research. The web-based interface also democratises pest monitoring by removing the requirement for entomological knowledge.

5 Conclusion or Future Work

The AIoT-Based Pest Classification System was successful in proving the concept of a real-time automated monitoring pest detection system through the integration of IoT devices and YOLOv11, which achieved an accuracy of 91.3% for the classification of 102 pest species that were domain expert-validated. All three objectives have been achieved: the IoT device's capability to sense the environment, the accuracy of the ML model that was achieved by exceeding 70%, and the reliability of the testing that involved the creation of datasets. The AIoT-Based Smart Automation Pest Classification System provides a cost-effective, economical, and accurate solution for precision farming. Future plans and possibilities include the retraining of the model to accommodate region-based datasets from Malaysia and the use of higher-resolution cameras (OV5640) and edge devices (NVIDIA Jetson Nano).

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SPEAKUP: AN INTELLIGENT WEB-BASED SOCIAL PLATFORM FOR UITM ARAU

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Abstract

This project introduces SpeakUp,an intelligent web-based social platform, aimed at improving communication between students and institutions in UiTM Arau. The majority of students have shown reluctance to express their feedback to the institutions due to issues related to privacy, institutional response time, and mistrust of existing feedback systems. The project aims to empower students to express their concerns and opinions anonymously, thereby improving transparency and student satisfaction. The proposed system utilizes modern web technologies and intelligent systems such as Artificial Intelligence and Natural Language Processing to efficiently analyze feedback and identify key issues. The proposed system adopted an Agile model in its development process, ensuring its align with user needs. The proposed system has undergone usability testing, functionality testing, user acceptance testing, and network performance testing. The study found that the proposed system achieved high user satisfaction in terms of perceived usefulness and usability. Students feel confident in expressing their opinions anonymously while institutions gained insights from students' feedback. The project also shown promising results in terms of response time and reliability during performance testing. To conclude, SpeakUp successfully incorporates anonymity, transparency, and Artificial Intelligence to improve communication effectivenes within the university environment.

Keywords: Anonymous Feedback, Web-Based Social Platform, Artificial Intelligence, Agile Development

1 Introduction

Effective communication between students and institutions plays a crucial role in improving academic services and student well-being. Continuous feedback allows institutions to refine infrastructure, administrative processes, and academic delivery (Abisuga et al., 2020). However, students often hesitate to provide honest opinions due to concerns over privacy, fear of negative consequences, and lack of trust in feedback systems (Kilari et al., 2020). Research indicates that tracking feedback may discourage participation when users perceive risks to their identity and personal safety (Kilari et al., 2020). Furthermore, anonymity has been described as a mechanism that enables individuals to express opinions freely without fear of repercussions (Jordan, 2019). Despite the importance of feedback for institutional improvement, existing platforms lack interactive and anonymous features that encourage open dialogue. Therefore, a secure and intelligent web-based social platform is needed to promote transparent, anonymous, and structured communication within UiTM Arau.

2 Methodology

The development of SpeakUp adopted the Agile methodology to ensure iterative refinement and flexibility throughout the system lifecycle, covering planning, design, development, testing, and deployment phases The system follows a web-based client–server architecture developed using Next.js and React for the frontend, and Node.js with RESTful APIs for backend services. PostgreSQL was used as the database system with Prisma ORM for data management. Authentication is restricted to verified UiTM domain accounts while preserving user anonymity within the platform. Automation features are powered by N8n Workflow Automation, which manages scheduled processes such as notification deletion and automated user banning based on predefined report thresholds. For intelligent text evaluation, a sentiment

analysis workflow was implemented using N8n integrated with the OpenAI language model. The workflow is triggered via webhook, processes submitted text, classifies it into Positive, Neutral, or Negative categories, and returns structured results to the system. Deployment was carried out using Docker containerization and Kubernetes (K8s) on DigitalOcean cloud infrastructure to ensure scalability, load balancing, and high availability

3 Results / Findings

System evaluation through usability, functionality, TAM-based user acceptance testing, and network performance testing demonstrates that SpeakUp is functional, user-friendly, and reliable. Students reported high perceived usefulness and ease of use, with anonymous posting increasing confidence in sharing opinions. Network testing showed acceptable response times, with most requests processed in under one second In addition, the system integrates N8n-based automation workflows, including notification management, automated user banning, and sentiment classification using OpenAI. The sentiment workflow categorizes user submissions into predefined polarity groups and provides moderation assistance as a precautionary mechanism.

4 Novelty of Project / Product / Project

SpeakUp integrates anonymous communication, structured institutional reporting, and AI-assisted sentiment analysis within a single web-based platform. Unlike traditional feedback systems, it combines social interaction features (likes, comments, voting) with formal complaint management and transparent tracking mechanisms. Supported by workflow automation and cloud-native deployment using Kubernetes, the system enhances scalability, moderation efficiency, and institutional responsiveness. The platform emphasizes understanding the intent behind feedback rather than identifying the user, fostering a safer and more open communication environment.

5 Conclusion or Future Work

SpeakUp addresses communication gaps between students and institutions at UiTM Arau by integrating anonymity, automation, and AI-supported analysis. Evaluation results demonstrate strong usability, functional reliability, user acceptance, and stable system performance. Future improvements include enhancing automated moderation capabilities, improving sentiment detection accuracy, expanding predictive analytics for trend identification, and developing a native mobile application to increase accessibility.

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LETRIK: WEB APPLICATION FOR BOOKING FREELANCE ELECTRICIAN WITH AI-BASED CHATBOT

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Abstract

The project was motivated by critical inefficiencies within Malaysia's freelance electrical services sector, where reliance on informal communication channels like WhatsApp frequently resulted in scheduling conflicts, miscommunication, and significant financial instability for service providers due to last-minute cancellations and the risk of scams. To overcome these challenges, the study adopted a structured Waterfall System Development Life Cycle (SDLC) methodology. The actual work involved the engineering of robust web-based architecture and incorporating automated status management and location validation for key service areas. A core novelty of the approach was the strategic integration of an OpenAI-powered AI Electrical Assistant, which provides users with 24/7 technical diagnostics and immediate safety guidance, alongside a secure Stripe-integrated payment gateway. Additionally, the system features verified portfolios to build client trust and real-time scheduling capabilities. An overview of the findings from an evaluation with 80 participants using the Post-Study System Usability Questionnaire (PSSUQ) demonstrated exceptional acceptance. The web application was also tested with system experts and stakeholders, who expressed satisfaction with the project and suggested improvements for future iterations. These results confirm the platform's readiness for deployment and its effectiveness in modernizing electrical service delivery while fostering trust in the digital marketplace. Future work aims to implement email verification for all user registrations to ensure valid contact information and reduce spam accounts. Next, this project also will implement Two-factor authentication (2FA) had to be implemented across all user roles and integrate queue system for background processing of emails and notifications.

Keywords: Malaysia's freelance, Laravel 12 framework, OpenAI-powered, Stripe-integrated, Post-Study System Usability Questionnaire (PSSUQ).

1 Introduction

This project focuses on creating a user-friendly web application that simplifies the booking of freelance electricians with AI technology. The project addresses the issues faced by clients when booking electricians, such as miscommunication, last-minute cancellations, lack of trust in informal booking systems, and no place for electrician put their image of their work. To develop a web application for both electricians and clients, integrating features like real-time scheduling, AI chatbots, and secure payment systems.

2 Methodology

This study uses Waterfall System Development Life Cycle (SDLC) methodology, systematically progressing through planning, requirement analysis, system design, implementation, and rigorous functional evaluation to create a centralized professional marketplace.

3 Results / Findings

In January 2026, a comprehensive evaluation of the Letrik platform was conducted to assess its readiness prior to deployment, encompassing functional validation, usability analysis, and performance testing. Functional testing confirmed that core system operations across

customers, electricians, and administrators were working correctly, including multi-role authentication, service booking, Stripe-based payment processing, and real-time chat features. Usability was assessed using the Post-Study System Usability Questionnaire (PSSUQ), complemented by User Acceptance Testing (UAT) involving one stakeholder and four domain experts guided by the Technology Acceptance Model (TAM) to evaluate perceived usefulness and deployment readiness. Performance testing, based on one week of network monitoring, yielded a score of 76/100 (grade C), with an average load time of 2.73 seconds and a page size of approximately 915 KB, indicating acceptable baseline performance; however, intermittent latency spikes of up to 36 seconds were observed, suggesting the need for further optimization, particularly in caching strategies and database query efficiency, to ensure stability and scalability under increased traffic conditions.

4 Novelty of Project

This Letrik use an AI-augmented electrical service marketplace that distinguishes itself through GPT-4-powered safety diagnosis and intelligent inquiry triaging, where customers receive instant AI analysis of electrical problems including safety level assessments, cost estimates, and professional requirement determinations before booking services. The platform features a context-aware chatbot utilizing OpenAI Function Calling to perform real-time database queries for electrician availability and services, while storing confidence scores and AI analysis metadata for continuous improvement.

5 Conclusion

Letrik is essentially a web platform designed to connect customers with certified electricians, effectively bridging the gap in the current market. We built the entire system using the Laravel framework, taking advantage of its MVC architecture and built-in security to ensure the code remained clean, scalable, and easy to maintain. It is more than just a simple directory, it is a fully functional marketplace that addresses actual industry needs. The platform supports multiple user roles, meaning customers, electricians, and admins all have their own specific dashboards and access levels

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BEHAVIORAL ANALYSIS OF GRAY HOLE AND SINKHOLE ATTACK USING AODV ROUTING PROTOCOL IN VEHICULAR AD HOC NETWORK (VANET)

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Abstract

Vehicular Ad Hoc Networks (VANETs) are essential for Intelligent Transportation Systems (ITS), enabling realtime communication to enhance road safety and traffic flow. However, their dynamic topology makes them vulnerable to network layer threats such as Gray Hole and Sinkhole attacks, which degrade reliability. This study presents a behavioral analysis of these attacks on the Ad hoc On-Demand Distance Vector (AODV) routing protocol. Simulations were conducted using Network Simulator 2 (NS-2) integrated with Simulation of Urban Mobility (SUMO) to model realistic traffic scenarios. The study evaluates performance metrics including throughput, end-to-end delay (EED), packet delivery ratio (PDR), and routing overhead across varying node densities and packet sizes. The findings reveal that Sinkhole attacks cause a catastrophic collapse in throughput dropping to 19.88 Kbps at 100 nodes, while Gray Hole attacks induce significant routing overhead peaking at 0.1138 due to persistent route repair cycles.

Keywords: VANET, AODV, Gray Hole Attack, Sinkhole Attack, Network Security

1 Introduction

VANETs facilitate vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, forming the backbone of modern ITS. Despite their benefits, the open wireless medium and high mobility of nodes render VANETs susceptible to routing attacks. Two severe threats are the Gray Hole attack, where malicious nodes selectively drop packets, and the Sinkhole attack, where a node attracts traffic by advertising false optimal routes before discarding it. These attacks compromise data integrity and safety-critical messaging. While the AODV protocol is widely used for its on-demand route discovery, it lacks inherent security mechanisms to verify routing advertisements. This research aims to simulate these attacks in a realistic environment to quantify their impact on network performance, providing a baseline for developing future mitigation strategies.

2 Methodology

The study employed a simulation-based approach integrating Network Simulator 2 (NS-2) for protocol modeling and SUMO for realistic vehicular mobility traces derived from OpenStreetMap. The AODV protocol was modified to simulate attack behaviors Gray Hole attacks selectively dropped 70% of packets, while Sinkhole attacks advertised false optimal routes (hop count 1) to attract traffic before dropping 100% of packets. Two scenarios were evaluated: varying node density (20–100 nodes) to test scalability, and varying packet sizes (1000–5000 bytes) to assess payload handling. Performance was measured using Throughput, End-to-End Delay (EED), Packet Delivery Ratio (PDR), Bit Error Rate (BER), and Routing Overhead (RO).

3 Results / Findings

The simulations revealed distinct behavioral impacts for each attack compared to normal operations. Sinkhole attacks caused the most severe throughput degradation, dropping from a normal peak of 646.72 Kbps (20 nodes) to just 19.88 Kbps at 100 nodes. Gray Hole attacks maintained a consistent but lower throughput (approx. 287 Kbps at 60 nodes) due to the 70% drop rate. Regarding latency, Sinkhole attacks peaked at 775.61 ms (40 nodes) as packets were forced onto suboptimal paths. Gray Hole attacks showed lower latency at high densities, but this was an artifact of high drop rates. However, Gray Hole attacks generated the highest routing overhead (peaking at 5.3168 at 80 nodes) due to persistent, unproductive route discovery cycles that exhausted network bandwidth.

4 Novelty of Project / Product / Project

This research distinguishes itself by moving beyond theoretical grid-based simulations to utilize a realistic urban mobility model rooted in OpenStreetMap data. Unlike standard simulations that use random waypoint models, this study integrates SUMO with NS-2 to replicate actual traffic dynamics, including road constraints and realistic vehicle interactions. This approach provides a higher fidelity assessment of how Gray Hole and Sinkhole attacks specifically exploit the AODV protocol in real-world driving conditions, offering more accurate data for the development of intrusion detection systems tailored for urban environments.

5 Conclusion or Future Work

This study confirms that both Gray Hole and Sinkhole attacks severely compromise VANET reliability. The Sinkhole attack proved most destructive to data availability, causing a 97% throughput loss at high densities due to aggressive traffic attraction. Conversely, the Gray Hole attack imposed a crippling administrative burden by generating excessive routing overhead. These findings expose the critical vulnerability of the standard AODV protocol, underscoring the urgent need for trust-based or cryptographic security measures to protect intelligent transport systems from internal threats.

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SERVER-SIDE REQUEST FORGERY ATTACK DETECTION USING MACHINE LEARNING TECHNIQUE

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Abstract

Server-Side Request Forgery (SSRF) attacks have become a significant and increasing threat in modern web applications. SSRF is a vulnerability that allows the attackers to manipulate the server side of an application to send unauthorized requests, potentially granting illegal access to internal resources while bypassing traditional security tools. However, most traditional detection tools struggle to keep up with the complex SSRF attack patterns because such tools heavily rely on static rule-based approaches and manual inspection techniques. This gap highlights the need for more effective and data-driven detection strategies. The purpose of this project is to explore how machine learning approaches can improve the accuracy of Server-Side Request Forgery attack detection. The main objectives of this project are to investigate the characteristics of SSRF attack types and the capabilities of machine learning techniques in the detection process, to develop SSRF detection using Random Forest and XGBoost machine learning techniques, and to evaluate the detection performance based on established metrics such as Accuracy, Precision, Recall, and F1-Score. The methodology involves the creation of a labelled HTTP requests dataset using a custom Python script, followed by feature extraction, and classification based on the Random Forest and XGBoost algorithms. The evaluation results demonstrate the effectiveness of the proposed models, with the Random Forest and XGBoost model achieving 94% accuracy in detecting SSRF attacks. This project contributes to the structured and data-driven SSRF detection system that improves the analysis of web application security by automated machine learning detection.

Keywords: Server-Side Request Forgery (SSRF), Machine Learning, Random Forest, XGBoost, Web Application Security

1 Introduction

Server-Side Request Forgery (SSRF) is a critical web application vulnerability that abuses server-side request functions to gain access to internal or restricted resources. It poses a significant risk to modern web applications, especially in cloud and microservices platforms. The SSRF attack are dangerous due to its ability to bypass the traditional network defences by exploiting trusted server-side components. Despite the commonly use of manual inspection tools to analyse HTTP requests, these tools are time-consuming and frequently fail to detect complex SSRF patterns. Therefore, machine learning techniques provide a viable alternative, as it can provide automated and adaptive detection depending on request behavior patterns.

2 Methodology

This project uses machine learning-based detection for detecting SSRF attacks based on HTTP request data. Custom Python scripts were used to generate a labelled dataset of benign and malicious HTTP request to produce various SSRF attacks. Feature extraction was performed on request attributes such as URLs, headers, parameters, and HTTP methods. The processed dataset was used to train Random Forest and XGBoost models. Accuracy, Precision, Recall, and F1-Score was used to evaluate the model's performance and determine the effectiveness of the detection ability.

3 Results / Findings

The results of the evaluation demonstrate that both Random Forest and XGBoost models are effective in distinguishing between benign and malicious HTTP requests. Both models successfully achieved approximately 94% accuracy, which shows a strong classification performance. The overall results shows that XGBoost exhibited slightly higher precision and recall scores, whereas Random Forest had a high precision with fewer false positives. These results validate that ensemble-based machine learning models can be efficient in SSRF detection.

4 Novelty of Project / Product / Project

The novelty of this project is the use of machine learning models, specifically in detecting SSRF attacks in web application. The detection system can provide a more flexible and scalable detection method, compared to traditional static rule-based tools by using feature-based analysis alongside predictive classification. Both Random Forest and XGBoost implementation offer comparative analysis and prove the efficiency of the models in cybersecurity applications.

5 Conclusion or Future Work

The conclusion of this project shows that machine learning techniques, specifically Random Forest and XGBoost techniques, can be utilized to improve the detection of Server-Side Request Forgery attacks. Based on the experimental results, XGBoost is the most suitable machine learning technique to be used in this project due to its higher recall and F1-score and the more stable detection results across different sizes of dataset, implying that XGBoost is more effective in detecting SSRF attack patterns. Furthermore, these detection systems able to minimizes the use of manual inspection tools and at the same time, enhances the efficiency of detection process by automated detection of HTTP request patterns. To further improve the detection capabilities, future work may involve expanding the dataset with more varied SSRF attacks forms, integrate with real-world traffic data, and exploring more advance machine learning or deep learning techniques to enhance detection performance.

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FEATURE SELECTION IMPACT ON ANDROID MALWARE DETECTION BETWEEN PCA AND CHI-SQUARE USING DECISION TREE

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Abstract

Android is the most widely used mobile operating system worldwide, and its open-source nature makes it a primary target for malware attacks. These attacks threaten user privacy, system integrity, and financial security, malware detection a critical research area. One major challenge in Android malware detection is handling high-dimensional feature sets produced through static analysis. These feature sets often contain irrelevant and redundant features, which can lower detection accuracy and increase computational overhead. This project investigates the effect of feature selection techniques on Android malware detection by comparing Principal Component Analysis and the Chi Square method using a Decision Tree classifier. Static analysis is performed by reverse engineering Android application packages using APKtool to extract permission-based features from the Android Manifest file. A balanced dataset of two thousand Android applications is used, consisting of one thousand malware samples and one thousand benign samples. Feature selection is applied using PCA and Chi Square with varying numbers of selected features to reduce dimensionality and enhance classification performance. The selected features are then used to train and evaluate a Decision Tree classifier. Performance is assessed using accuracy, precision, recall, F1 score, and training time. Experimental results show that PCA achieves about ninety three percent accuracy.

Keywords: APKtool, Principal Component Analysis (PCA), Chi-Square, Decision Tree, Malware, Benign

1 Introduction

Operating systems are critical software components that support the efficient functioning of modern computing platforms such as computers, smartphones, and embedded systems. Worldwide operating system market trends have shifted rapidly due to advances in mobile technology, smart devices, and Internet of Things applications. Current market share statistics indicate that Android leads with 45.68 percent, followed by Windows at 25.75 percent, iOS at 7.84 percent, OS X at 3.65 percent, unknown systems at 2.67 percent, and macOS at 2.00 percent. Studies confirm Android as the most widely used operating system globally (Pathak et al., 2024). Despite this dominance, Android's open-source nature increases its exposure to malware threats. Android malware can steal data, locations, send messages secretly, display advertisements, lock devices, or install malicious software (M. Khalid et al., 2024).

2 Methodology

This study applies a static analysis–based methodology to evaluate the impact of feature selection on Android malware detection. A balanced dataset of 2,000 Android applications, consisting of 1,000 malware and 1,000 benign samples, is used for experimentation. APKtool is employed to reverse engineer APK files and extract permission-based features from the AndroidManifest.xml file. The extracted features are converted into numerical vectors for analysis. Feature selection is then performed using Principal Component Analysis (PCA) and the Chi-Square method to reduce dimensionality and remove irrelevant features. The selected features are used to train a Decision Tree classifier. Model performance is evaluated using

accuracy, precision, recall, F1-score, and training time to compare the effectiveness and efficiency of both feature selection techniques.

3 Results / Findings

The results show that feature selection significantly affects Android malware detection performance. Using all features produced lower efficiency, while applying PCA and Chi Square improved classification results. PCA achieved the highest accuracy of about 93 percent when more components were retained but required longer training time. In contrast, the Chi Square method reached approximately 86 percent accuracy using fewer features and much faster training time. These findings highlight a trade-off between detection accuracy and computational efficiency in practice systems

4 Novelty of Project / Product / Project

The novelty of this project lies in its focused and systematic comparison of two distinct feature selection techniques, Principal Component Analysis (PCA) and the Chi-Square method, applied to Android malware detection using a Decision Tree classifier. Unlike many existing studies that prioritize only detection accuracy or rely on a single feature selection approach, this project evaluates both classification performance and computational efficiency, including training time. By using a balanced dataset and permission-based static features extracted through reverse engineering, the study provides clear insights into the trade-off between accuracy and efficiency, offering practical guidance for designing lightweight and effective Android malware detection systems.

5 Conclusion or Future Work

This project evaluated feature selection effects on Android malware detection by comparing PCA and Chi-Square using a Decision Tree classifier. Static analysis extracted permission-based features from APK files, and a balanced dataset of 2,000 malware and benign applications was used. Results show feature selection significantly improves accuracy and efficiency. PCA achieved higher accuracy when more components were retained, preserving complex feature relationships. Chi-Square achieved strong accuracy with fewer features by selecting statistically significant permissions, making it more efficient overall performance.

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SIMULATION-BASED ANALYSIS OF DISTRIBUTED DENIAL-OF-SERVICE (DDoS) ATTACKS IN 5G NETWORK USING OMNeT++

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Abstract

Fifth Generation (5G) networks introduce high data rates, ultra-low latency, and massive device connectivity through virtualized and software-defined architectures. However, these advancements expand the attack surface and increase vulnerability to Distributed Denial-of-Service (DDoS) attacks. Existing studies have demonstrated that DDoS traffic degrades network performance, yet limited work identifies quantitative attacker thresholds under varying radio conditions. This study presents a simulation-based evaluation of DDoS attacks in a 5G standalone network using OMNeT++ integrated with the INET framework and Simu5G library. DDoS behaviour is emulated through high-rate Constant Bit Rate (CBR) traffic generated by multiple attacker User Equipment (UE). Two experimental scenarios are analysed: (i) varying UE–gNodeB distance, and (ii) introducing neighbouring cell interference. The number of attacker nodes is progressively increased to identify the degradation threshold. Network performance is measured using End-to-End Delay (EED) and Throughput. Results reveal non-linear delay behaviour and substantial throughput degradation as attack intensity increases. Performance deterioration occurs earlier under longer UE–gNodeB distances and in the presence of neighbouring cells. The findings highlight the importance of considering radio environment factors when assessing 5G network resilience against DDoS attacks.

Keywords: 5G Network, DDoS Attack, OMNeT++, Simu5G, Network Performance

1 Introduction

5G networks enable enhanced mobile broadband (eMBB), ultra-reliable low-latency communication (URLLC), and massive machine-type communication (mMTC). However, the adoption of Software-Defined Networking (SDN), virtualization, and network slicing expands the attack surface. One of the most critical threats is the Distributed Denial-of-Service (DDoS) attack, which overwhelms shared resources and disrupts legitimate services. Pagadala and Ahmed (2023) showed that increasing attacker nodes degrades throughput and increases delay in 5G environments. Khan et al. (2022) further demonstrated that DDoS traffic affects network slice performance. Additionally, signalling storm vulnerabilities and control-plane exploitation have been identified in 5G architectures, while SDN flexibility may introduce new attack vectors (Bjerre et al., 2022). Despite these findings, limited studies quantitatively determine attacker thresholds under varying radio conditions. This study therefore aims to identify the performance degradation threshold of DDoS attacks in a 5G standalone network while considering UE distance and neighbouring cell interference.

2 Methodology

A 5G standalone network was modelled using OMNeT++ with the INET framework and Simu5G library. The topology consists of one serving gNodeB, a legitimate User Equipment (UE), and multiple attacker UEs. DDoS traffic is emulated using high-rate Constant Bit Rate (CBR) flows generated by attacker nodes. The number of attackers is gradually increased to observe degradation behaviour and determine the attacker threshold. Two scenarios are evaluated. Scenario A varies the UE–gNodeB distance (50 m, 100 m, 200 m) to examine signal quality effects. Scenario B introduces neighbouring cells (0, 1, and 2 background cells) to simulate inter-cell interference. Network performance is assessed using End-to-End Delay

(EED) and Throughput. The attacker threshold is identified when throughput drops by approximately 50% with severe delay escalation.

3 Results / Findings

Increasing attack intensity progressively degrades network performance. In Scenario A, larger UE–gNodeB distances cause earlier throughput collapse due to reduced signal strength and increased sensitivity to congestion. In Scenario B, neighbouring cell interference significantly amplifies degradation. Additional background cells increase resource contention, leading to earlier throughput reduction compared to distance variation alone. A non-linear delay trend is observed. Delay initially rises due to congestion, briefly stabilizes as packet drops increase, and then spikes sharply when network resources are exhausted. These results indicate that radio conditions strongly influence DDoS severity in 5G environments.

4 Novelty of Project

This study contributes by identifying quantitative attacker thresholds rather than only reporting general degradation trends. Unlike previous works conducted under fixed configurations, this research integrates realistic radio variations, including UE distance and neighbouring cell interference. The findings demonstrate that neighbouring cell interference produces stronger performance degradation than distance variation alone. By combining structured threshold analysis with OMNeT++–Simu5G simulation, this work provides a practical evaluation framework for assessing 5G resilience under DDoS conditions.

5 Conclusion or Future Work

The results confirm that 5G networks experience significant degradation under DDoS attacks, with earlier thresholds occurring under weaker radio conditions and neighbouring cell interference. Physical-layer deployment factors therefore play a critical role in network resilience. Future work may incorporate mitigation mechanisms and additional performance metrics to enhance security evaluation.

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IOT-BASED WATER QUALITY MONITORING FOR CAMPER AT JERNIH HILL RIVER USING ESP32 WI-FI MODULE

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Abstract

The growing popularity of river-based recreation at locations like Jernih Hill River, Perlis, necessitates immediate water quality assessment to ensure safety for activities such as bathing and cleaning. Conventional laboratory testing is often impractical for real-time use due to significant time delays and the logistical challenges of manual sampling. To address this, this study developed a low-cost, portable monitoring system utilizing Internet of Things (IoT) technology cantered on the ESP32 microcontroller. The device integrates sensors to continuously monitor three critical indicators of water health: temperature, turbidity, and Total Dissolved Solids (TDS). Data is transmitted wirelessly to the Blynk platform for real-time mobile visualization, while Google Sheets provides a cloud-based infrastructure for long-term data logging and automated analysis. A core feature of the system is its ability to trigger instant alerts if water parameters exceed safety thresholds, providing campers with actionable safety information. Field testing at the river site confirmed that the system maintains high data accuracy and connectivity even under varying environmental conditions. The results demonstrate that this IoT framework offers a reliable, user-friendly, and cost-effective alternative to traditional methods. By providing live insights into river conditions, the system not only mitigates health risks for outdoor enthusiasts but also fosters greater environmental awareness regarding the importance of continuous water resource management. Despite long-term maintenance considerations, the setup proves to be an effective tool for decentralized environmental monitoring in remote recreational areas.

Keywords: Internet of Things, Water Quality Monitoring, ESP32, River Monitoring, Camper Safety

1 Introduction

Malaysia continues to face challenges in maintaining river water quality due to agricultural runoff, domestic waste, and environmental pollution. Jernih Hill River, located in Perlis, is a recreational area frequently visited by campers. Despite its popularity, the river lacks a real-time monitoring system to inform users about current water conditions. Campers often rely on visual observation, which is insufficient to detect invisible contamination. Traditional monitoring approaches based on manual sampling and laboratory testing do not provide immediate results. Therefore, an IoT-based real-time monitoring solution is required to improve water safety awareness and support sustainable recreational use.

2 Methodology

This study employed a prototype-based development approach. An ESP32 Wi-Fi module was integrated with temperature, turbidity, and TDS sensors to collect real-time water quality data. The ESP32 processes sensor readings and transmits data wirelessly via Wi-Fi. The Blynk IoT platform is used to display real-time data on a mobile interface, while Google Sheets stores historical data using App Script integration. Field testing was conducted at Jernih Hill River to evaluate system functionality, connectivity, and data reliability.

3 Results / Findings

The system successfully measured and transmitted real-time water quality data during field testing. Sensor readings for temperature, turbidity, and TDS were displayed correctly on the Blynk dashboard and stored automatically in Google Sheets. Notification alerts functioned as expected when parameter values exceeded safety thresholds. The results demonstrate stable system performance, reliable wireless communication, and effective real-time monitoring in an outdoor river environment.

4 Novelty of Project / Product / Project

The novelty of this project lies in the application of an ESP32 -based IoT monitoring system tailored specifically for camper safety at a recreational river. Unlike conventional monitoring methods, the system provides continuous real-time data, cloud storage, and automated alerts, enabling immediate awareness of water quality conditions.

5 Conclusion or Future Work

In conclusion, the developed IoT-based water quality monitoring system provides an effective and low-cost solution for real-time monitoring at Jernih Hill River. The system enhances camper safety and environmental awareness through continuous data collection and notification features. Future work may include the integration of additional sensors such as pH and dissolved oxygen, as well as long-term data analysis for predictive water quality assessment.

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AIOT-BASED WILD DOG DETECTION AND DETERRENT PROTOTYPE FOR DEER FARM PROTECTION IN UiTM PERLIS BRANCH

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Abstract

Wild dog intrusion represents a persistent threat to deer farming operations by endangering livestock safety, increasing animal stress, and causing economic losses, particularly in farms that rely on conventional and labor-intensive surveillance methods. This study presents an Artificial Intelligence of Things (AIoT)-based wild dog detection and deterrent prototype developed to enhance deer farm protection at UiTM Perlis. The proposed system integrates Internet of Things (IoT) devices and artificial intelligence to enable automated monitoring, intelligent animal recognition, and real-time response. The hardware architecture consists of an ESP32-CAM for image capture and streaming, an Arduino Nano for control logic, a PIR motion sensor for movement detection, a stepper motor for directional camera positioning, and a passive piezo buzzer as a non-lethal deterrent. A YOLO-based deep learning model is implemented through a Python script using OpenCV to classify animals and accurately identify wild dogs. Upon confirmed detection, the system automatically activates the buzzer, sends real-time alerts with image evidence via Telegram, and records detection data in Google Sheets for monitoring and analysis. The prototype was evaluated through functionality testing, network testing, and usability assessment using the System Usability Scale (SUS). Results indicate reliable system operation, accurate detection with minimal false alarms, stable communication performance, and good user acceptance with a SUS score of 71.88. The findings demonstrate that the proposed prototype offers a cost-effective, humane, and intelligent solution for deer farm protection while reducing reliance on manual surveillance and supporting sustainable wildlife management practices.

Keywords: [AIoT (Artificial Intelligence of Things), Wild Dog Detection, Deer Farm Protection, YOLO-based Image Recognition, Automated Wildlife Deterrent]

1 Introduction

Wildlife intrusion is a growing issue in livestock farming, where predator attacks threaten animal safety and farm productivity. Traditional deterrents such as fencing and manual surveillance are costly, labor-intensive, and often ineffective against adaptive predator behavior (Chen et al., 2024). Recent advances in IoT and AI enable automated monitoring and intelligent detection in agriculture (Mishra & Yadav, 2024). Deep learning models like YOLO improve animal classification and reduce false alarms (Delwar et al., 2025). At the UiTM Perlis deer farm, repeated wild dog intrusions have increased reliance on human patrols. Therefore, this project proposes an AIoT-based detection and deterrent system integrating motion sensing, AI recognition, automated deterrence, and real-time alerts to enhance farm security.

2 Methodology

The project followed phases of planning, design, development, and testing. The prototype integrates an ESP32-CAM, Arduino Nano, PIR sensors, stepper motor, and piezo buzzer. Motion detection triggers camera alignment toward the movement source. Captured images are streamed to a Python script using OpenCV and YOLOv3 for dog detection. When a dog is confirmed, the system activates the buzzer, sends Telegram alerts with images, and logs data in Google Sheets. Evaluation was conducted in controlled settings using functionality testing

to verify operations, network testing to measure response time, and System Usability Scale surveys to assess user acceptance.

3 Results / Findings

Results indicate that the prototype functioned reliably. All components operated correctly, including motion detection, AI recognition, deterrent activation, alerts, and data logging. The system effectively ignored non-target objects such as deer and humans, reducing false alarms. Response time ranged from about 3–4 seconds at close distances to around 7 seconds at longer distances due to processing and camera movement. Alerts were consistently delivered. The SUS score of 71.88 indicates good usability. Users found the system practical and helpful in reducing manual monitoring. Overall, the system proved responsive and suitable for smart farm protection.

4 Novelty of Project / Product / Project

The project is novel in combining AI-based animal recognition with IoT-enabled automated deterrence specifically for deer farms. Unlike simple motion-triggered systems, it uses YOLO classification and directional camera control to confirm wild dog presence before triggering responses, reducing false alarms. Real-time Telegram alerts with images improve decision-making, while Google Sheets logging supports intrusion analysis. The system is cost-effective, using affordable hardware and open-source AI. Since most prior work focuses on crop protection, applying this approach to deer farm security offers a new contribution to livestock protection technology.

5 Conclusion or Future Work

The AIoT-based prototype successfully improved deer farm protection through automated detection and deterrence. It delivered reliable performance, real-time alerts, and positive usability feedback while reducing manual surveillance. However, detection accuracy may be limited by a small training dataset, and the system depends on stable internet connectivity. Future work should expand the dataset, apply data augmentation, and retrain the model for robustness. Integrating GSM, LTE, or LoRaWAN and adding local data storage can improve reliability in rural areas. These improvements would enhance scalability and allow adaptation for other wildlife threats.

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PLEUROTUS OSTREATUS IRRIGATION SYSTEM AT UiTM PERLIS'S PLANTATION UNIT USING IOT TECHNOLOGY AND BLYNK APPLICATION

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Abstract

The cultivation of Pleurotus ostreatus (oyster mushroom) represents a significant agricultural opportunity in Malaysia, yet its potential is constrained by inefficient, labor intensive manual climate monitoring. Hence, this project has developed and evaluated a practical Internet of Things (IoT) prototype to automate environmental control at the UiTM Perlis Plantation Unit. The system integrates a DHT22 sensor, an ESP32 microcontroller, and the Blynk IoT platform to enable real-time monitoring and autonomous regulation of temperature and humidity. Experimental testing confirmed the prototype's operational efficacy. Functionality tests demonstrated actuator response times of less than one second for both cooling and misting systems. Network reliability was validated, with remote alert delivery via Telegram averaging 4.8 seconds. A user centric evaluation using the System Usability Scale (SUS) yielded an above-average score of 70.4, indicating good acceptance by the target operators. These results collectively verified that the prototype successfully maintains optimal growing conditions, streamlines resource management, and reduces manual labor. The project culminated in a functional prototype that provides a foundation for more efficient, data driven mushroom cultivation. Future work should focus on expanding the system's sensor suite, implementing machine learning for predictive control, and conducting a broader adoption study with commercial farmers to enhance its robustness and scalability. This research demonstrates a viable pathway for modernizing small-scale agricultural practices through accessible IoT technology.

Keywords: Pleurotus ostreatus (oyster mushroom), Irrigation system, ESP32, DHT22,, Blynk application

1 Introduction

The cultivation of *Pleurotus ostreatus*, or oyster mushroom cultivation offers strong commercial potential in Malaysia. However, the UiTM Arau Plantation Unit still relies on manual monitoring methods. These methods are labour-intensive and struggle to maintain stable temperature and humidity, leading to inconsistent yields and wasted resources. This project aimed to address this by developing and evaluating an IoT-based prototype to automate environmental control.

2 Methodology

This project used the DHT22 sensor for temperature and humidity monitoring, an ESP32 microcontroller for processing and wireless communication, and a 2-channel relay module to control a cooling fan and a piezoelectric atomizer for misting. The system was programmed using Arduino IDE and connected to the Blynk IoT platform for remote monitoring. Three evaluations were conducted: functionality testing for actuator speed, network testing for dashboard update latency, and usability testing using the System Usability Scale (SUS) questionnaire with six plantation unit respondents.

3 Results / Findings

The findings show the prototype met all objectives. The cooling fan and atomizer activated in under one second on average (847 ms and 880 ms). Dashboard updates recorded average latencies of 1.35 seconds for the fan and 1.51 seconds for the atomizer. Telegram alerts for high temperature averaged 4.8 seconds. The SUS score was 70.4, indicating above average usability. All tests were completed successfully with zero failures.

4 Novelty of Project

This prototype uses low-cost, locally sourced components costing under RM200. It replaces conventional water pumps with a piezoelectric atomizer for finer mist and lower power consumption. The system provides both instant local actuation and cloud-based remote monitoring. It is also specifically documented for Malaysia's tropical climate, filling a gap left by studies focused on temperate regions.

5 Conclusion or Future Work

The developed prototype successfully automates environmental control for oyster mushroom cultivation. It is fast, reliable, and well-received by its intended users. The project proves that effective IoT systems can be built affordably for small-scale adoption. Future work should add more sensors, implement predictive control, and conduct longer field trials with commercial farmers.

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WEB-BASED HANDWRITTEN SIGNATURE VERIFICATION WITH DEEP LEARNING USING SIAMESE CONVOLUTIONAL NEURAL NETWORK

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Abstract

Handwritten signatures remain a widely accepted biometric authentication method due to their legal recognition and ease of use. However, traditional signature verification approaches often suffer from subjectivity, inconsistent accuracy, and vulnerability to skilled forgeries. This paper presents a web-based handwritten signature verification system leveraging deep learning, specifically a Siamese Convolutional Neural Network (CNN). The proposed system operates within an offline verification framework, utilizing static signature images rather than dynamic writing features. The Siamese CNN architecture is designed to learn similarity measures between pairs of signatures by extracting discriminative feature embeddings through twin subnetworks with shared weights. The model was trained and evaluated using publicly available signature datasets containing genuine and forged samples. Experimental results demonstrate strong verification performance, achieving high accuracy with low False Acceptance Rate (FAR) and False Rejection Rate (FRR), indicating reliable differentiation between genuine and forged signatures. The trained model was integrated into a Flask-based web application, enabling real-time verification without requiring retraining. The system provides a user-friendly interface for signature upload, secure authentication, and verification history management. The findings confirm that Siamese CNNs offer an effective solution for writer-independent signature verification while maintaining scalability and accessibility through web deployment.

Keywords: Signature Verification, Siamese CNN, Deep Learning, Biometric Authentication, Flask

1 Introduction

Handwritten signatures continue to play a critical role in identity verification across banking, legal, and administrative domains. Despite their widespread usage, manual verification processes are often prone to human error, inconsistency, and bias. The increasing reliance on digital platforms highlights the need for automated and reliable verification systems. Recent advancements in deep learning have enabled models to learn complex visual features directly from images, offering improved robustness compared to traditional handcrafted feature-based approaches (Xiao & Ding, 2022). This study proposes a web-based offline handwritten signature verification system utilizing a Siamese CNN to address challenges related to signature variability and forgery detection.

2 Methodology

This project adopts an offline signature verification approach using static signature images. Publicly available datasets containing genuine and forged signatures were used for model training. Images underwent preprocessing, including grayscale conversion, normalization, resizing, and edge enhancement. A Siamese CNN architecture was employed to learn similarity relationships between signature pairs (Hirunyawanakul et al., 2021). The model was trained using contrastive learning principles to minimize distances for genuine pairs and maximize distances for forged pairs. The trained model was deployed within a Flask-based web application, enabling real-time inference.

3 Results / Findings

The findings of this study show that the Siamese CNN achieved high verification accuracy with 99.63%, demonstrating strong capability in distinguishing genuine signatures from skilled forgeries. FAR and FRR metrics remained low 0.11% and 0.17% indicating balanced security and usability. System testing confirmed efficient response times suitable for real-time web-based verification.

4 Novelty of Project / Product

This project integrates a similarity-based deep learning model within a fully functional web-based system. Unlike conventional classification approaches, the Siamese CNN enables writer-independent verification without retraining (Babu et al., 2025). The web deployment enhances accessibility, scalability, and practical applicability.

5 Conclusion or Future Work

In general, the developed system demonstrates that Siamese CNNs provide an accurate and scalable solution for offline handwritten signature verification. Future work may include incorporating online signature dynamics, adaptive threshold optimization, and enhanced security mechanisms to prevent database manipulation or adversarial attacks.

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IOT-BASED SMART LPG GAS LEAK DETECTION PROTOTYPE WITH SAFETY INTERVENTION AND ALERTS IN COMMERCIAL KITCHEN

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Abstract

Liquefied Petroleum Gas (LPG) is widely used in commercial kitchens due to its efficiency and affordability; however, undetected gas leaks can lead to serious hazards such as fires, explosions, and health risks. Conventional LPG detection systems mainly rely on local alarms, which are ineffective when no personnel are present. This project presents an IoT-based smart LPG gas leak detection prototype with automated safety intervention and real-time alerts for commercial kitchen environments. The system utilizes an MQ-2 gas sensor integrated with an ESP32 microcontroller to detect gas leakage, activate a buzzer and exhaust fan, and send instant notifications to users through the Blynk mobile application. The prototype was developed using Arduino IDE and evaluated through functional testing, network performance testing, and the Technology Acceptance Model (TAM). The TAM results indicate a high level of user acceptance, with an average mean score of 4.61 for Perceived Usefulness (PU), 4.36 for Perceived Ease of Use (PEU), and 4.43 for Behavioral Intention to Use (IU), reflecting strong agreement among respondents regarding the system's usefulness, usability, and intention for adoption. Experimental findings further show that the system successfully detects LPG leaks, triggers safety responses within seconds, and delivers alerts reliably under various network conditions. Future enhancements are recommended, including the integration of an automatic gas shut-off valve, additional sensors for improved detection accuracy, and cloud-based analytics for long-term monitoring. Overall, the developed system offers a practical and cost-effective IoT-based safety solution for gas-powered commercial kitchens.

Keywords: IoT, LPG gas detection, ESP32, real-time monitoring, smart safety system

1 Introduction

Liquefied Petroleum Gas is commonly used in restaurants and food preparation areas because of its high energy efficiency and low operational cost. Despite these advantages, LPG leakage remains a major safety concern that can cause severe accidents, property damage, and human casualties. Traditional gas detectors typically provide only on-site alarms without remote monitoring capability, making them insufficient for unattended environments. Therefore, integrating IoT technology into gas safety monitoring offers a more proactive and intelligent solution through real-time detection, automated response, and remote notification.

2 Methodology

This projec adopted a prototype development approach consisting of hardware integration, software configuration, and system evaluation. The hardware components include an MQ-2 gas sensor, ESP32 microcontroller, buzzer, exhaust fan, and relay module. Software development was carried out using Arduino IDE and the Blynk IoT platform for real-time monitoring and notification. System performance was evaluated through functional testing, network testing response time analysis across different distances and telecommunication providers, and user acceptance assessment using the Technology Acceptance Model (TAM).

3 Results / Findings

The findings of this project show that the prototype is successfully detected LPG leakage beyond the predefined threshold and automatically activated the buzzer, exhaust fan, and remote notifications. Network testing indicated that response time remained consistent and within an acceptable range regardless of distance, demonstrating reliable real-time communication. TAM analysis revealed strong positive acceptance in perceived usefulness, perceived ease of use, and behavioral intention to use, indicating that users consider the system beneficial, easy to operate, and suitable for practical implementation.

4 Novelty of Project / Product / Project

The novelty of this project lies in combining automatic safety intervention, real-time IoT monitoring, and remote mobile notification within a single low-cost prototype tailored for commercial kitchen environments. Unlike conventional detectors, the system not only alerts users but also initiates ventilation response to reduce gas concentration immediately.

5 Conclusion or Future Work

In conclusion, the IoT-based Smart LPG Gas Leak Detection system effectively enhances early warning capability, reduces emergency response time, and improves safety management in gas-powered commercial kitchens. Future improvements may include integration of an automatic gas shut-off valve, multi-sensor detection for higher accuracy, and cloud data analytics for predictive safety monitoring.

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DEVELOPMENT OF A WIRELESS FRAMEWORK FOR IOT LOCKER USING ESP-NOW PROTOCOL WITH LOAD-BASED ITEM MONITORING AND WORKFLOW AUTOMATION

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Abstract

As Internet of Things (IoT) technology advances, secure and automated storage systems are increasingly required in educational and organizational environments. Traditional lockers rely on manual operation and lack real-time monitoring, leading to inefficiencies and limited security. This project proposes a wireless IoT locker framework using ESP-NOW for low-latency peer-to-peer communication combined with load-based item monitoring and workflow automation. The system integrates ESP32 microcontrollers, load cell sensors, magnetic reed switches, and solenoid locks to enable real-time item detection and automated notifications. Experimental evaluation demonstrated stable communication, accurate load detection, and responsive automation without relying on centralized infrastructure. The proposed framework provides a reliable and scalable smart locker solution, with future enhancements focusing on extended communication coverage and improved notification intelligence.

Keywords: Internet of Things (IoT), ESP-NOW, Smart Locker, Load-Based Monitoring, Workflow Automation

1 Introduction

The growing demand for secure and intelligent storage systems in universities, offices, and shared environments highlights the limitations of traditional lockers that rely on manual keys or PIN-based mechanisms without real-time monitoring. Such systems lack transparency, automation, and operational efficiency, particularly in multi-user or delivery scenarios (Suwondo & Ngatoilah, 2024). Although recent smart locker solutions integrate wireless connectivity and remote access features, many depend heavily on internet-based infrastructure, which introduces reliability concerns in unstable network environments (Rishwanth et al., 2023). Research on ESP-NOW demonstrates its capability for low-latency, peer-to-peer communication without continuous Wi-Fi dependency (Abdul et al., 2022). Therefore, this study proposes a wireless IoT locker framework using ESP-NOW combined with load-based item monitoring and workflow automation to improve reliability, security, and operational efficiency in localized deployments.

2 Methodology

The system was developed using a five-phase lifecycle consisting of planning, design, development, testing, and evaluation. The architecture includes multiple ESP32-based locker nodes communicating with a master controller via ESP-NOW protocol, eliminating the need for a central access point. Each node integrates a load cell with HX711 amplifier for item detection, a magnetic reed switch for door status monitoring, and a solenoid lock for automated access control. Load-based monitoring has been shown to provide accurate weight detection for automated systems. The master controller connects to the Blynk platform for real-time monitoring, while workflow automation is implemented using n8n to manage event-driven

notifications and system processes. System testing evaluated communication reliability, RSSI performance, response time, and sensor accuracy.

3 Results / Findings

Experimental results indicate that the system achieved stable ESP-NOW communication with reliable packet delivery under indoor conditions. RSSI measurements confirmed consistent signal performance within practical deployment distances, while load cell testing verified accurate detection of item placement and removal. Door status monitoring and solenoid lock control functioned correctly, supporting secure access management. Response time analysis demonstrated low-latency communication suitable for real-time operations, and full workflow testing confirmed accurate execution of automated notifications and system events. Overall, the system met its objectives in terms of communication reliability, monitoring accuracy, and automation responsiveness.

4 Novelty of Project / Product / Project

The novelty of this project lies in combining offline ESP-NOW peer-to-peer communication with load-based item monitoring and workflow automation within a smart locker framework. Unlike conventional IoT lockers that rely heavily on cloud-based Wi-Fi systems, the proposed architecture reduces internet dependency while maintaining low latency and energy efficiency. The integration of load cell sensing enhances security by detecting real-time item presence rather than relying solely on door access events, while the separation of workflow logic through n8n improves modularity and scalability. This integrated approach offers a resilient and flexible IoT solution for localized smart storage applications.

5 Conclusion or Future Work

The proposed wireless framework for IoT locker demonstrates that ESP-NOW can provide reliable, low-latency communication without centralized infrastructure, while load-based monitoring and workflow automation enhance system intelligence and operational transparency. The solution is suitable for secure shared storage environments requiring efficient and scalable management. Future work may focus on extending communication coverage through relay nodes or hybrid communication models to reduce signal degradation in larger deployments, as well as improving AI-based item classification and expanding multi-channel notification support to further strengthen monitoring capabilities.

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IMPLEMENTING VPN PROTOCOLS PERFORMANCE IN HIGH-LATENCY NETWORKS:

WIREGUARD VS OPENVPN VS IPSEC

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Abstract

This study investigates the performance accuracy of WireGuard, OpenVPN, and IPsec (strongSwan) under high-latency network conditions. The increasing use of VPNs in latency-sensitive applications introduces performance degradation due to encryption and tunneling overhead, particularly over delayed network links. The objective of this research is to determine which VPN protocol maintains the highest throughput stability and lowest degradation as latency increases from 50 ms to 300 ms. A virtualized Ubuntu 24.04 environment was developed using VMware Fusion, with latency emulated through Linux traffic control (tc/netem). Throughput was measured using iPerf3 and timed 100 MB and 200 MB file transfers, while round-trip time was obtained using ICMP testing, and results were compared against a non-VPN baseline. The findings reveal that WireGuard achieved the most consistent throughput performance. At 200 ms latency for 100 MB transfers, WireGuard recorded a 3.77% throughput improvement, while OpenVPN achieved 1.89% under the same condition. At 300 ms latency, IPsec showed the highest degradation with a 45.21% throughput reduction compared to lower-latency measurements. These results demonstrate that VPN protocol architecture significantly impacts performance sustainability in high-latency environments, with WireGuard identified as the most suitable protocol for latency-sensitive applications. Future work will extend the analysis to include packet loss, jitter variation, and larger-scale deployment scenarios for broader validation.

Keywords: WireGuard, OpenVPN, IPsec, video streaming, VPN performance, file size and high-latency

1 Introduction

Virtual Private Networks (VPNs) remain essential for securing traffic over untrusted networks, but their runtime behaviour can change dramatically in high-latency environments. Existing literature often evaluates protocols under low-latency or LAN conditions; this work fills a gap by systematically comparing WireGuard, OpenVPN and IPsec under controlled, repeatable high-latency emulation to derive evidence-based recommendations for practitioners and researchers. The study objectives, scope, and experimental design are documented in the project report.

2 Methodology

This study used a repeatable virtual testbed was implemented on a MacBook Air M2 host running VMware Fusion with five Ubuntu 24.04 VMs: three clients (each assigned one VPN protocol in Scenario B), one VPN server, and one video server. Two scenarios were run: (A) baseline video streaming **without** VPN, and (B) streaming **with** VPN (WireGuard, OpenVPN, IPsec). Traffic shaping used tc/netem to impose one-way delays of 50, 100, 200 and 300 ms in clients. Video payloads were prepared as 100 MB and 200 MB files (via fallocate) and transferred with curl / time; throughput benchmarks used iperf3; RTT was sampled using ping (20 ICMP echoes). Data collection and post-processing (tables, plots) were performed in Excel. Configuration steps and key parameters (ciphers, MTU, user/kernel mode for each VPN) are provided in the appendices.

3 Results / Findings

The experimental evaluation demonstrates that network latency significantly affects VPN performance, with varying degrees of degradation observed across protocols. Baseline testing without VPN achieved the highest throughput, indicating the measurable overhead introduced by encryption and tunneling mechanisms. Among the evaluated protocols, WireGuard demonstrated the most stable and consistent performance as latency increased from 50 ms to 300 ms. At 200 ms delay for 100 MB transfers, WireGuard achieved a 3.77% throughput improvement, while OpenVPN recorded 1.89% under the same condition. At 300 ms latency, IPsec showed the greatest degradation, with a 45.21% throughput reduction compared to lower-latency performance. Overall, WireGuard maintained better throughput scalability and lower fluctuation under high-latency stress, indicating superior efficiency in delayed network environments.

4 Novelty of Project / Product / Project

This project provides a focused evaluation of VPN protocol performance specifically under controlled high-latency conditions, which is less emphasized in conventional studies. By implementing a reproducible virtualized testbed using Ubuntu and traffic control latency emulation, the research ensures consistent and fair comparison across WireGuard, OpenVPN, and IPsec. The contribution lies in quantifying protocol behavior using measured percentage differences, enabling clearer protocol selection for latency-sensitive applications. The structured methodology and documented configurations also support future replication and extended research in real-world or larger-scale environments.

5 Conclusion or Future Work

The experiments confirm that VPN choice matters for latency-sensitive workloads. WireGuard's lightweight, kernel-level design generally offers superior throughput and competitive RTT in low–to–moderate latency, while OpenVPN and IPsec trade performance for compatibility and feature maturity; IPsec, in particular, can suffer larger throughput losses at extreme delays. These results support selecting WireGuard for latency-sensitive streaming when compatibility allows, and motivate further work to test packet loss, jitter, larger files, and real/cloud-based topologies to generalize findings. Limitations and recommendations for future research are provided in the report appendices.

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FEATURE SELECTION IMPACT BETWEEN PCA AND CHI-SQUARE ON ANDROID MALWARE DETECTION USING RANDOM FOREST ALGORITHM

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Abstract

The rapid growth of Android applications has significantly increased the prevalence of mobile malware, posing serious security and privacy risks to users. One of the main challenges in Android malware detection is the feature overload problem, where high-dimensional permission-based features complicate the learning process of machine learning models and reduce computational efficiency. In addition, identifying the most relevant features remains difficult, as different feature selection techniques may lead to varying detection performance. This study investigates the impact of feature selection techniques on Android malware detection using machine learning. Reverse engineering was performed on Android application packages (APKs) to extract permission-based features from AndroidManifest.xml files. A dataset consisting of 2,000 Android applications was analysed. Principal Component Analysis (PCA) and Chi-Square feature selection methods were applied to reduce feature dimensionality prior to classification using a Random Forest algorithm. Experimental results demonstrate that PCA effectively preserves feature correlations and achieves higher detection accuracy, particularly for larger datasets. PCA attained approximately 91% accuracy when using 20 and 50 principal components. In contrast, the Chi-Square method achieved around 90% accuracy when selecting the top 50 features. Although PCA provided better accuracy, Chi-Square required significantly lower training time due to its simpler statistical evaluation of individual feature relevance. These findings highlight the trade-offs between accuracy and computational efficiency and provide useful insights for designing practical Android malware detection systems.

Keywords: Malware, Feature Selection, Machine Learning, Feature Extraction, Reverse Engineering.

1 Introduction

Android's open-source ecosystem has made it a frequent target for malware attacks. Machine learning-based detection methods using static permission analysis are widely adopted due to their safety and effectiveness (Guyton et al., 2022; Muzaffar et al., 2023). However, high-dimensional permission data often leads to feature overload, negatively impacting detection accuracy and computational efficiency. Feature selection techniques such as PCA and Chi - Square have therefore been widely explored to address this issue (Bhat & Dutta, 2022; Pathak et al., 2024).

2 Methodology

This study employed a static analysis approach on 2,000 Android applications consisting of benign and malicious samples. Apktool was used to reverse engineer APK files and extract permission features from AndroidManifest.xml files. The extracted permissions were encoded as binary feature vectors. Principal Component Analysis (PCA) and Chi-Square methods were applied for feature selection, followed by classification using a Random Forest model. Performance was evaluated based on classification accuracy and training time.

3 Results / Findings

The experimental results show that feature selection significantly improves the performance of the Android malware detection model. PCA achieved the highest accuracy, approximately 91%, when using 20 and 50 principal components. This indicates that PCA effectively preserves important feature relationships, especially in large datasets. The Chi-Square method achieved slightly lower accuracy, around 90%, when selecting the top 50 features. However, Chi-Square consistently demonstrated faster training times compared to PCA. This is due to its lower computational complexity, as it evaluates each feature independently without performing matrix transformations. These findings suggest that PCA is more suitable when detection accuracy is the primary objective, while Chi-Square is preferable for scenarios requiring faster training and lower computational overhead.

4 Novelty of Project

The novelty of this study lies in its systematic comparison of PCA and Chi-Square feature selection techniques within the context of Android malware detection using a fixed classifier and dataset size. The study highlights the trade-off between accuracy and efficiency and provides empirical evidence on how feature selection impacts both detection performance and computational cost. This analysis supports informed decision-making in the design of practical malware detection systems.

5 Conclusion

In conclusion, this study demonstrates that feature selection plays a crucial role in enhancing Android malware detection performance. PCA provides higher accuracy by preserving feature correlations, while Chi-Square offers faster training with slightly reduced accuracy. The results emphasise the importance of selecting an appropriate feature selection technique based on system requirements. Future work may explore hybrid feature selection approaches, additional machine learning classifiers, and larger datasets to further improve detection robustness. Incorporating dynamic analysis features could also enhance detection accuracy against more sophisticated malware.

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K-MEANS CLUSTERING ANALYSIS OF NETWORK ATTACKS BASED ON COWRIE HONEYPOT LOGS

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Abstract

Traditional intrusion detection systems (IDS) largely depend on signature-based techniques, which are ineffective against evolving and previously unseen network attacks. This study applies K-Means clustering to analyze network attack behaviors based on logs collected from a Cowrie medium-interaction SSH honeypot. A controlled virtual environment was deployed to simulate brute-force, reconnaissance, and data exfiltration activities. The collected logs were parsed, reconstructed into session-level records, and transformed into structured behavioral features such as failed logins, command diversity, session duration, and file transfer indicators. A total of 1,791 SSH sessions were analyzed. The optimal number of clusters was determined using the Elbow Method and Silhouette Score, resulting in K = 3. The clustering results revealed three distinct behavioral groups corresponding to brute-force dominated sessions, reconnaissance-oriented interactions, and data exfiltration activities. Principal Component Analysis (PCA) was used to visualize cluster separation and validate the behavioral distinctions. The findings demonstrate that unsupervised K-Means clustering can effectively identify meaningful SSH attack patterns without relying on labeled datasets, providing a lightweight and interpretable behavior-based approach for enhancing network security analysis.

Keywords: Cowrie Honeypot, K-Means Clustering, Network Attacks, Unsupervised Learning, Behavioral Analysis

1 Introduction

The rapid growth of Internet-connected systems has led to an increase in network attacks targeting exposed services. Traditional Intrusion Detection Systems (IDS) rely mainly on signature-based detection, which is limited in identifying new or evolving attack behaviors. To address this limitation, behavior-driven analysis using honeypot data provides a practical approach for capturing real attacker interactions. This study focuses on transforming Cowrie honeypot logs into structured session-level features and applying K-Means clustering to identify distinct network attack patterns. The objective is to demonstrate that unsupervised learning can effectively group attack behaviors without relying on predefined labels, supporting more adaptive network security analysis.

2 Methodology

A controlled virtual environment was deployed using a Cowrie honeypot to collect real network attack data, including brute-force, reconnaissance, and data exfiltration activities. The captured logs were parsed and reconstructed into session-level records, followed by feature extraction to generate structured behavioral attributes. Feature scaling was applied before implementing the K-Means clustering algorithm to group attack sessions based on similarity. The optimal number of clusters was determined using the Elbow Method and Silhouette Score, and PCA was used to visualize cluster separation and support result interpretation.

3 Results / Findings

The clustering analysis on 1,791 reconstructed network attack sessions identified an optimal configuration of K = 3 using the Elbow Method and Silhouette Score. The results revealed

three distinct behavioral groups representing brute-force, reconnaissance, and data exfiltration activities, differentiated by authentication intensity, command diversity, session duration, and file transfer indicators. PCA visualization showed clear separation between clusters, supporting the interpretability of the grouping structure. These findings confirm that K-Means clustering can effectively distinguish network attack behaviors without relying on labeled datasets.

4 Novelty of Project / Product / Project

The novelty of this project lies in the application of a lightweight and interpretable unsupervised K-Means clustering approach to analyze structured session-level features derived from Cowrie honeypot logs. Unlike studies that depend on labeled datasets or complex deep learning models, this research focuses on transforming semi-structured honeypot logs into behavior-oriented features and identifying network attack patterns without predefined labels. The project demonstrates that meaningful attack behavior grouping can be achieved using a simple, reproducible clustering pipeline for behavior-driven network security analysis.

5 Conclusion or Future Work

This study presented a behavior-driven analysis of network attacks using K-Means clustering on structured session-level features extracted from Cowrie honeypot logs. By deploying a controlled virtual environment and simulating brute-force, reconnaissance, and data exfiltration activities, raw semi-structured logs were transformed into meaningful behavioral attributes suitable for unsupervised learning. The clustering results, validated using the Elbow Method and Silhouette Score, demonstrated that three distinct behavioral groups could be effectively identified without relying on labeled datasets. The findings confirm that unsupervised K-Means clustering can reveal interpretable and meaningful network attack patterns based on authentication behavior, command usage, and data transfer characteristics. Overall, the study highlights the effectiveness of a lightweight and reproducible clustering approach in supporting behavior-based network security analysis and providing adaptive insights beyond traditional signature-based detection methods.

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PERFORMANCE EVALUATION OF DOS AND ARP SPOOFING ATTACK DETECTION IN WIRELESS MESH NETWORK USING RASPBERRY PI

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Abstract

Denial of Service (DoS) and Address Resolution Protocol (ARP) spoofing attacks create many serious security issues for Wireless Mesh Networks (WMNs). On these networks, multi-hop communication is delivered wirelessly via a decentralized architecture. Due to the distributed structures of WMNs and the open wireless medium, WMNs are at a high risk for these types of attacks. WMNs will experience serious degradation in performance caused by depletion of network resources, interruption of routing processes, and unauthorized tampering with the integrity of network data. To exhibit a lightweight, practical framework for evaluating the detection capabilities of various attack detection methods under realistic WMN conditions, a test bed was constructed using Raspberry Pi devices and the B.A.T.M.A.N. Advanced routing protocol. Suricata was utilized as an intrusion detection system (IDS) solution for detecting the attacks and PRTG Network Monitor was used for real-time performance measurement. A series of DoS and ARP spoofing attacks were performed on the testbed for the purpose of analyzing the performance impacts of the attacks by examining throughput, end-to-end delay, and bandwidth utilization. Results of the experiments indicate that the impact of DoS attacks on throughput and end-to-end delay was caused in large part by the excessive bandwidth consumption of the attack. Additionally, the results indicate that ARP spoofing attacks negatively impacted routing stability and degraded overall network performance. Based on the results of the experiments, the proposed low-cost Raspberry Pi-based testing environment is an effective method for recognizing and evaluating network-based attacks within a decentralized WMN, ultimately yielding beneficial knowledge regarding reductions in performance due to attacks and attack detection efficacy.

Keywords: Wireless Mesh Network, Denial-of-Service, ARP Spoofing, Intrusion Detection System, Raspberry Pi

1 Introduction

The use of wireless mesh networks (WMNs) is growing exponentially in smart cities, community networks, and IoT-based infrastructures because they are decentralized and self-healing. However, due to a lack of centralized control and reliance on co-operative routing, WMNs are also vulnerable to many security threats. Some examples of these types of attacks that take advantage of the vulnerabilities in WMNs include denial-of-service (DoS) and address resolution protocol (ARP) spoofing. These attacks can cause severe performance problems and result in disruption of service. As a result, it is very important to evaluate the performance of various types of attack detection mechanisms in real WMN environments in order to make them sustainable with regard to reliability and security.

2 Methodology

This study implemented a real WMN testbed using Raspberry Pi 3 Model B+ devices configured with the B.A.T.M.A.N. Advanced routing protocol. Suricata IDS was deployed for signature-based attack detection, while PRTG Network Monitor was used to observe network performance metrics. Three experimental scenarios were conducted: normal operation, DoS attack, and ARP spoofing attack. Throughput, end-to-end delay, and bandwidth utilization were recorded and analyzed to evaluate performance degradation and detection effectiveness.

3 Results / Findings

The results indicate bandwidth utilization and end-to-end latency are increased due to DoS attacks, while effective throughput is decreased. Routing stability is disrupted due to ARP spoofing attacks, introducing additional delay through redirection of traffic. Successful real-time alerts were generated by Suricata during attack conditions, confirming detection. Results validate that both attacks impact WMN performance negatively and that the proposed framework can detect these attacks successfully.

4 Novelty of Project / Product / Project

The novelty of this project lies in the implementation of a lightweight, real-world Wireless Mesh Network testbed using Raspberry Pi devices for performance evaluation of DoS and ARP spoofing attack detection. Unlike simulation-based studies, this project provides practical validation in a resource-constrained environment and integrates performance monitoring with intrusion detection to analyze real attack impacts.

5 Conclusion or Future Work

To sum up, this project effectively showed how a Raspberry Pi-based mesh network system can determine if performance impacts resulting from DoS and ARP spoofing have occurred. The results demonstrate that decentralized mesh networks are vulnerable to both availability and integrity-based attacks. Future work should include integrating an anomaly-based or machine learning approach to detection, increasing the number of nodes in the mesh network, and exploring other types of attacks in a real-world context.

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COMPARATIVE ANALYSIS OF RANDOM FOREST AND DECISION TREE FOR DETECTING SQL INJECTION AND XSS WEB ATTACKS

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Abstract

Web applications have become the primary target for cyberattacks, with SQL Injection (SQLi) and Cross-Site Scripting (XSS) remaining the most prevalent threats (Brasoveanu et al., 2020). Traditional signature-based Web Application Firewalls (WAFs) often fail to detect these attacks when obfuscation techniques are employed, leading to high false negative rates. This study presents a comparative analysis of two machine learning algorithms, Random Forest and Decision Tree, for the automated detection of SQLi and XSS payloads. A Hybrid Feature Extraction method combining Term Frequency-Inverse Document Frequency (TF-IDF) Character N-Grams and Shannon Entropy was utilized to capture both keyword patterns and the randomness associated with obfuscated code. The models were trained and tested using a dataset comprising malicious logs from the Acunetix Vulnerability Scanner and normal web traffic. The results demonstrate that the Random Forest model achieved a superior accuracy of 98.4% and an Area Under the Curve (AUC) of 0.999, outperforming the Decision Tree model (98.0%). Furthermore, Random Forest significantly reduced the False Positive rate, validating its robustness for real-time web threat detection.

Keywords: Web Security, Machine Learning, SQL Injection, XSS, Random Forest, Feature Extraction.

1 Introduction

Web applications are critical digital infrastructure but remain primary targets for cyberattacks, with SQL Injection (SQLi) and Cross-Site Scripting (XSS) persisting as dominant threats. Traditional Web Application Firewalls (WAFs) struggle to mitigate these threats due to their reliance on static signatures, which fail against obfuscation techniques like URL encoding and string splitting(Kumar et al., 2024). This limitation creates an "automation gap," where manual security updates cannot keep pace with high-speed, automated attacks. Consequently, there is a growing necessity to transition toward Machine Learning (ML) solutions that detect attacks based on behavioural patterns rather than fixed signatures (Saxena et al., 2022). This research addresses this need by comparing two supervised learning models which is Random Forest and Decision Tree to identify the most effective algorithm for detecting obfuscated web attacks.

2 Methodology

The study followed a structured pipeline utilizing a dataset of standard HTTP logs and malicious traffic generated by the Acunetix Web Vulnerability Scanner. Preprocessing involved decoding URL-encoded strings to address obfuscation. A key innovation was the development of a Hybrid Feature Extraction engine, combining TF-IDF Character N-Grams to identify attack sequences and Shannon Entropy to measure URL randomness. This processed data was used to train and test Random Forest and Decision Tree classifiers using Python libraries such as Scikit-learn, Pandas, and NumPy.

3 Results / Findings

The performance of the models was evaluated using a 30% testing dataset, focusing on metrics such as Accuracy, Precision, Recall, and the Receiver Operating Characteristic (ROC) curve.

The comparative analysis revealed that the Random Forest model achieved a higher overall accuracy of 98.4%, slightly outperforming the Decision Tree model, which achieved 98.0%. More critically, the Confusion Matrix analysis demonstrated the superior stability of the Random Forest algorithm. While both models correctly identified most attacks, Random Forest reduced the number of False Positives (normal traffic misclassified as attacks) to just 3, compared to 7 in the Decision Tree model. This reduction is vital for minimizing disruptions to legitimate users. The ROC curve analysis further confirmed this superiority, with Random Forest achieving a near-perfect Area Under the Curve (AUC) score of 0.999, compared to 0.981 for the Decision Tree. Feature importance analysis indicated that entropy and url_length were among the top predictors, validating the hypothesis that combining mathematical properties with textual patterns is highly effective for detecting obfuscated web attacks.

4 Novelty of Project / Product / Project

The primary contribution of this study is the development of a Hybrid Feature Extraction engine that integrates TF-IDF Character N-Grams with Shannon Entropy. Unlike traditional signature-based methods, this approach detects obfuscated SQL Injection and XSS payloads by analyzing both textual patterns and statistical randomness. Furthermore, the model is trained on a dynamic dataset generated by the Acunetix Web Vulnerability Scanner, ensuring effectiveness against modern, automated threats rather than outdated static datasets. The resulting Random Forest model achieved 98.41% accuracy and reduced the False Positive rate by over 50% compared to the Decision Tree baseline, validating its robustness for real-time application.

5 Conclusion or Future Work

This study successfully demonstrates the viability of Machine Learning for automating the detection of SQL Injection and XSS attacks. The results conclude that the Random Forest algorithm provides a more robust solution than the Decision Tree, offering higher accuracy and a significantly lower False Positive rate. The implementation of Hybrid Feature Extraction proved effective in identifying obfuscated payloads that typically evade traditional WAFs. Future work will focus on integrating Deep Learning models to further enhance the detection of complex, split-syntax XSS attacks.

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DETECTION PERFORMANCE ANALYSIS OF WAZUH SIEM AGAINST ADVERSARY EMULATION USING ATOMIC RED TEAM

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Abstract

The rapid growth of cyber threats has increased the need for advanced detection mechanisms beyond traditional signature-based methods. Signature-based detection depends on known attack patterns, making it ineffective against new or modified threats. This project proposes a behaviour-based detection framework by analysing threat actor behaviour using the MITRE ATT&CK framework. The study focuses on PowerShell-based attacks, specifically technique T1059.001, which is commonly used by attackers to execute malicious commands and scripts. The system environment is developed using Wazuh integrated with ELK Stack for log collection, monitoring, and analysis. Atomic Red Team is used to simulate real-world adversary techniques in a controlled virtual environment. Sysmon is deployed to generate detailed system activity logs including process creation, command-line execution, and registry modification. Detection rules are implemented using behavioural indicators and string-matching rules to evaluate detection effectiveness. The findings show that behaviour-based detection improves threat visibility and can detect suspicious PowerShell activities even when attackers modify command patterns. The integration of open-source tools provides a cost-effective and practical solution for cybersecurity monitoring and threat detection.

Keywords: Behavior-Based Detection, Threat Actor Behavior, Atomic Red Team, Wazuh, MITRE ATT&CK

1 Introduction

Modern organisations face increasing cybersecurity threats due to the evolution of attacker techniques. Traditional signature-based detection systems are limited because they rely on predefined attack signatures. Attackers often modify their techniques to bypass these systems. Behavior-based detection provides a better approach by analysing abnormal system activities and attacker behaviour patterns. This project focuses on analysing threat actor behaviour using adversary emulation techniques. By mapping attack simulations to MITRE ATT&CK techniques, organisations can better understand attacker strategies and improve detection capability.

2 Methodology

This study used the virtual lab environment consisting of Windows endpoint and Wazuh monitoring server. Atomic Red Team is used to simulate attack scenarios based on MITRE ATT&CK techniques. Sysmon is configured to capture detailed endpoint activities. Collected logs are forwarded to Wazuh for analysis. Custom detection rules are created to detect suspicious behaviour patterns. The experiment includes baseline normal activity and simulated attack scenarios to evaluate detection performance.

3 Results / Findings

The findings of this study show that the system successfully detected suspicious PowerShell activities using behavioral detection rules. The monitoring system was able to identify abnormal execution behaviour even when command variations were introduced. The integration of Wazuh and ELK Stack improved log visibility and helped security analysts perform faster investigation and analysis.

4 Novelty of Project / Product / Project

This project demonstrates the integration of adversary emulation with behavior-based detection using open-source tools. The framework provides a practical approach for organisations and educational institutions to study real attacker behaviour in a controlled environment.

5 Conclusion or Future Work

The project proves that behaviour-based detection is more effective in detecting modern cyber threats compared to traditional signature-based detection. Future work may include expanding attack technique coverage and integrating machine learning for advanced threat detection.

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DEVELOPMENT OF AN IoT-BASED SMART WASTE MONITORING AND ALERT NOTIFICATION SYSTEM FOR APARTMENT TRASH ROOMS

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Abstract

Malaysian apartments face chronic waste problems due to bin overcrowding, irregular collection, and no real-time monitoring. This paper presents an IoT-based Smart Waste Monitoring and Alert System for indoor trash rooms. It uses an ESP32-C3, HC-SR04 ultrasonic sensor (0.30 cm mean error), SIM800L GSM module, and WS2812B LED strip. A three-level alert (WHITE <30cm normal, ORANGE 30-40cm warning, RED >40cm critical) triggers SMS to ERT and web pop-ups. Tests show 95% SMS delivery, <3s response, 92.3% resident approval of LEDs, and 100% ERT reporting improved efficiency. The system reduces unnecessary rounds and overflow, enabling data-driven waste collection.

Keywords: IoT, Smart Waste Monitoring, Ultrasonic Sensor, GSM Notification, Real-Time Dashboard

1 Introduction

Malaysia generates over 38,000 metric tons of municipal solid waste daily, >80% from households (SWCorp, 2023). Fixed apartment collections cause overflow, odors, pests, and resident dissatisfaction. Existing IoT waste solutions are outdoor-focused, Wi-Fi dependent, lack real-time visual feedback, and have no false-alarm validation. This project fills gaps with a GSM-redundant, indoor-optimized system featuring three-level color-coded LEDs, SMS alerts, and a real-time Firebase dashboard. Objectives: (i) design an IoT system using ultrasonic sensing, GSM, and multi-channel notifications; (ii) test its accuracy, reliability, responsiveness, and user acceptance in a real apartment setting.

2 Methodology

The system uses a Waterfall model (5 stages) with an ESP32-C3, HC-SR04 sensor (±3mm accuracy), and Arduino C++ firmware. It classifies fill levels as Normal (<30 cm), Warning (30–40 cm), or Critical (>40 cm). A SIM800L sends SMS and HTTPS PUT updates to Firebase, while a WS2812B LED strip provides visual feedback. The web dashboard (HTML5/CSS3/JS) consumes Firebase data via WebSocket. Testing at Razak City Residence evaluated sensor accuracy (vs. tape measure), GSM success rate (40 attempts), latency, and user acceptance (26 residents, 10 ERT members).

3 Results / Findings

The ultrasonic sensor achieved a mean absolute error of 0.30 cm (1.63% error), with <0.2 cm error at critical thresholds (30/40 cm). GSM SMS success rate was 95% (38/40 attempts), mean latency 2.831s (under 5s), with automatic failure recovery. Sensor-to-LED response <100ms, state change detection <1s, dashboard update 1.2–1.5s, and 100% Firebase success. Survey results: 69.2% of residents face overflow “Very Often”; 92.3% rely on color-coded LED indicators. All ERT members (100%) confirmed RED alerts and automated notifications improve efficiency. Overall, 91.7% of stakeholders (Likert 4.69/5) agreed the system would

greatly enhance apartment cleanliness.

4 Novelty of Project / Product / Project

The project's key innovations include: GSM-based alerts (no Wi-Fi needed), WS2812B LEDs (white/orange/red) with a 10 cm safety zone for three-tier fill levels, and multi-channel redundancy (on-site LED, web dashboard pop-ups, direct SMS). Dual-trigger SMS logic sends real-time state-change alerts plus periodic critical updates to balance urgency and alert fatigue. Lightweight cloud integration uses native ESP32 HTTPS libraries (~150 KB memory) instead of the Firebase SDK. Sensor validation across successive cycles prevents false alarms from temporary blockages.

5 Conclusion or Future Work

The developed IoT-powered Smart Waste Monitoring System has proven to handle the overflow of trash in apartments and the trash rooms successfully in terms of accurate sensing, trusted GSM-related notices, and robust support amongst the stakeholders and turn waste collection into a proactive, data-driven process instead of a reactive, time-based one. Additional work (Multi-sensor fusion (ultrasonic+weight+infrared)) will be added to predict fills more effectively, machine learning predictive analytics will be implemented to optimise collection routes, a solar-powered battery backup will be added to enable energy independence, multi-bin deployments will be scaled with the support of a centralised building management interface, and it will be linked to municipal waste APIs to be able to coordinate logistics at a city-level scale.

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ADVERSARY EMULATION AND DETECTION MAPPING IN ALIENVAULT OSSIM (SIEM) USING MITRE ATT&CK

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Abstract

Organizations today face complex cyber threats and often struggle to verify whether their SIEM systems can detect advanced attacks. This study evaluates the effectiveness of AlienVault OSSIM, an open-source SIEM, using simulated attack scenarios. A controlled lab environment was set up with Windows 10 and Ubuntu systems, where MITRE Caldera was used to simulate attacks such as privilege escalation, credential theft, and internal reconnaissance. System data was collected using Sysmon, OSSEC, and NXLog, and sent to OSSIM for real-time monitoring. The results showed a 100% detection rate, with OSSIM successfully generating alerts for critical activities like bypassing security controls, stealing credentials, and network scanning. By mapping these alerts to the MITRE ATT&CK framework, the study demonstrates that OSSIM is a cost-effective solution for detecting advanced cyber threats.

Keywords: AlienVault OSSIM, MITRE ATT&CK, MITRE Caldera, Emulation, Detection

1 Introduction

In today's fast-changing cyber threat environment, organizations find it difficult to detect modern attacks, with breaches taking an average of 277 days to identify and stop. Many SIEM systems also fail to cover most known attack techniques, creating visibility gaps. To address this, this project combines threat detection with attack simulation using AlienVault OSSIM as the monitoring system and MITRE Caldera to mimic real attack behaviours. The study tests scenarios such as privilege escalation, credential theft, and internal reconnaissance to evaluate how well the system detects and correlates threats. The results provide a practical approach for organizations to improve security by turning passive monitoring into a proactive defence system aligned with the MITRE ATT&CK framework.

2 Methodology

This study was conducted in six phases: information gathering, planning, development, experimentation, analysis, and documentation. In the development phase, a virtual lab was built using VirtualBox, including an Ubuntu attacker machine running MITRE Caldera and an AlienVault OSSIM server as the SIEM. A Windows 10 machine was used as the target, equipped with Sysmon, OSSEC, and NXLog to collect and send logs. During the experiment phase, three types of attacks were simulated: privilege escalation, credential theft, and internal reconnaissance. Data from these attacks was collected and sent to OSSIM for analysis. In the final phase, the alerts generated were compared with the MITRE ATT&CK framework to evaluate detection performance and identify any gaps.

3 Results / Findings

The results showed that the monitoring setup was very effective, achieving a 100% detection rate for all simulated attacks. AlienVault OSSIM successfully processed data from the Windows 10 system and turned it into useful security alerts. In the first scenario, it detected

privilege escalation activities like UAC bypass and process injection. In the second scenario, it identified credential theft from the system and browsers, triggering a "Default Credentials" alert. In the final scenario, it detected internal reconnaissance through network scanning and service discovery. Overall, the findings show that combining OSSIM with tools like Sysmon and OSSEC can effectively detect advanced attacks and map them to the MITRE ATT&CK framework.

4 Novelty of Project / Product / Project

The novelty of this project lies in the seamless integration of an automated offensive framework with an open-source defensive ecosystem to create a structured validation loop for security monitoring. Unlike traditional research that often evaluates either offensive tactics or defensive detection in isolation, this study demonstrates a complete end-to-end workflow by operationalizing MITRE ATT&CK through MITRE Caldera to test AlienVault OSSIM. A key innovation is the deployment of a specialized telemetry stack by combining Sysmon, OSSEC, and NXLog which bridges the visibility gap common in standard SIEM deployments. This configuration allows for the transformation of raw, high-volume endpoint data into high-fidelity correlation alerts, providing a cost-effective, battle-tested blueprint for organizations to validate their defensive posture without relying on expensive commercial solutions.

5 Conclusion or Future Work

This research successfully met its objectives by demonstrating that an open-source SIEM can achieve a 100% detection rate for advanced adversarial techniques when supported by refined endpoint telemetry. The manual mapping of alerts to the MITRE ATT&CK framework provided the actionable context necessary for security teams to identify and remediate visibility gaps in scenarios involving privilege escalation, credential harvesting, and discovery. While the laboratory setting proved highly effective for baseline validation, future work should focus on automating the mapping process through the ATT&CK Navigator API to reduce human error and improve scalability. Additionally, expanding the environment to include complex, multi-subnet network topologies would allow for the assessment of lateral movement and the performance impact of logging agents in a production-scale architecture.

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DEVELOPMENT OF A SMART Wi-Fi-BASED PARENTAL CONTROL SYSTEM WITH REAL-TIME USAGE MONITORING AND SCREENTIME RESTRICTION

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Abstract

The rapid proliferation of internet use by children has created a concern about excessive screen time, the absence of supervision of children when accessing online information, and the constraints of the current parental control technologies that are largely based on the application of the devices. The existing solutions are mostly intrusive and can be easily bypassed, and potentially cause privacy concerns because of the presence of monitoring applications in the devices. To solve these problems, the proposed project is a Smart Wi-Fi-Based Parental Monitoring System, which will allow parents to monitor and regulate internet access on a central level in the network. Some of the project goals are the real-time monitoring of the devices connected to it, controlled access to the internet depending on the circumstances of use, and restrictions according to time to promote healthy online behaviours. The installation takes place on an OpenWRT-enabled router, on which the internet access control is imposed with the help of firewall rules provided by iptables. A web-based dashboard that is developed in PHP and JavaScript enables parents to control devices and access them easily. DHCP lease information is used to identify and monitor devices, and a system of logging is used to maintain records of system usage. The functional testing indicates that the system is capable of identifying connected devices correctly, blocking and restoring internet connection effectively, and automatically enforcing access restrictions based on time without having to prompt the user. In general, the findings demonstrate that the offered router-level solution is efficient, secure, and practical, which can provide a privacy-saving and non-invasive alternative to application-based parental control systems and make using the internet safer and more responsible in the home network settings.

Keywords: Parental control, openWRT, Wi-fi network, screen time, real-time monitoring.

1 Introduction

The extensive internet use by children has become a significant issue for parents because of the risks of spending too much time on the screen, viewing unsuitable material, and the absence of the efficient control. The past methods of parental control, such as manual supervision and device-based applications, tend to be less effective and can be easily circumvented by individuals with a technical background. Moreover, application-based solutions can also result in the lack of user privacy and complicated configurations on several gadgets. Thus, there is an increasing demand to centralized and non-invasive parental control mechanism that will work on the network level. This paper is concerned with the idea of developing a parental control system based on Wi-Fi, which will allow the parents to control all the devices connected to the network through the single point of control.

2 Methodology

This study used the Waterfall Model, which includes such steps as the requirement analysis, the system design, the implementation, testing, and the documentation. A wireless router with an OpenWRT-based operating system forms the basis of deployment of the system. The system architecture is in the form of a three-layer design that includes a web interface layer, a control logic layer, and a network enforcement layer. Detection of devices is done by use of DHCP lease information, and the internet access control is done by means of iptables firewall rules. Time-based access control and mode switching, including Education Mode is automated using

shell scripts. A web-based dashboard is applied to offer an easy-to-use interface to parents to manage the system functionality.

3 Results and Findings

The findings of this study show that functional testing is used to ensure that the system can identify connected devices, impose limitations on internet access, and restore access to the internet based on a set of rules. According to the performance testing of the network, the implementation does not have a significant effect on the latency, throughput, and packet loss during the normal conditions of the network functioning. According to the analysis of the User Acceptance Testing, the outcomes demonstrate that the system is positively received regarding its usability, interface comprehensibility, and general satisfaction, which suggests that it can be used by non-technical users under home conditions.

4 Novelty of Project

This project is novel in that it provides an implementation of parental control at the network level by the use of an OpenWRT router, which does not use device-level software installation. The system is a tamper-free and privacy-saving solution to traditional application-based countermeasures due to the ability to enforce access control using firewall rules and centralized control.

5 Conclusion and Future Work

To sum up, the Smart Wi-Fi-Based Parental Control System is an effective way to overcome the disadvantages of the available parental control solutions by offering centralized, secure, and user-friendly internet management at the network level. The system has been able to meet its goals without having a significant impact on the performance of the network. Further work can involve the incorporation of application-level traffic classification, remote access to the dashboard, and the better data analytics to track long-term usage.

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REAL-TIME BLUETOOTH LOW ENERGY DEVICE DETECTION WITH IoT INTEGRATION FOR OFFICE ENVIRONMENT

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Abstract

The increasing presence of Bluetooth Low Energy (BLE)–enabled devices in modern office environments has created new challenges in device monitoring and security management. Devices such as smartphones, laptops, wearables, and IoT equipment continuously transmit Bluetooth signals that operate independently of traditional network infrastructure, making them difficult to detect using conventional monitoring systems. As a result, unauthorized or rogue BLE devices may enter office premises undetected, posing potential risks including data leakage, impersonation, and ineffective asset management. This project proposes a real-time Bluetooth Low Energy device detection system with IoT integration for office environments, designed to passively monitor BLE devices without requiring pairing or user interaction. The system utilizes multiple ESP32 microcontrollers configured as BLE scanners to continuously capture BLE advertisement packets from nearby devices. Detected device information, including MAC address, device name, Received Signal Strength Indicator (RSSI), and detection timestamp, is transmitted to a central server and displayed on a web-based monitoring dashboard. An alert mechanism is also implemented to notify administrators when unauthorized BLE devices are detected within the monitored area. System performance was evaluated through comprehensive testing, including functionality testing, RSSI stability analysis, device scanning reliability testing, and end-to-end detection latency measurement under different scenarios. Experimental results show that the proposed system is capable of reliably detecting BLE devices in near real time, with acceptable latency and consistent detection performance in an office environment. Despite RSSI fluctuations caused by environmental factors, the system effectively enhances real-time visibility of BLE device presence. Overall, the project demonstrates a practical and scalable IoT-based solution for improving BLE device monitoring and security in office environments.

Keywords: Bluetooth Low Energy (BLE), Real-Time Device Detection, Internet of Things (IoT), Passive Scanning, Unauthorized Device Monitoring

1 Introduction

Modern offices contain numerous Bluetooth-enabled devices such as smartphones, laptops, wearables, and IoT sensors that continuously transmit detectable signals. Traditional monitoring systems mainly rely on Wi-Fi, making them unable to detect Bluetooth-only devices and creating security gaps in the network. Although Bluetooth Low Energy (BLE) enables convenient short-range communication, it also exposes offices to risks from unauthorized or rogue devices that may cause data theft or cyberattacks (Barua et al., 2022). Additionally, administrators lack effective tools to monitor and manage Bluetooth device activity within the workplace. Kumar et al., (2021), who states that an IoT-based prototype utilizing BLE is an efficient method to provide time saving solution for issue of inventory and asset tracking. Therefore, an IoT-based BLE monitoring system that provides real-time visibility and alerts is essential to enhance security, device control, and overall office safety.

2 Methodology

This project followed a structured system development life cycle with planning, design, development, testing, and evaluation. System requirements and tools were identified, and the architecture, network layout, and hardware setup were designed. ESP32 microcontrollers were programmed as BLE scanners to detect nearby devices and send data to a central server. A

Node-RED web dashboard visualized devices in real time, with alerts for unauthorized devices. Finally, functionality and network tests were conducted to evaluate detection accuracy, responsiveness, and overall effectiveness.

3 Results / Findings

The results show that the proposed BLE monitoring system successfully detected nearby Bluetooth Low Energy devices in real time within the office environment. Functionality testing confirmed reliable device scanning, data transmission, dashboard visualization, and alert generation. The ESP32 scanners consistently captured MAC address, RSSI, and timestamp information with minimal data loss. RSSI stability tests demonstrated predictable signal variation with distance, while latency tests indicated fast dashboard updates within a few seconds. Scanning reliability remained high even when multiple devices and wireless interference were present. Overall, the findings validate that the system provides accurate, responsive, and dependable BLE presence monitoring suitable for practical office deployment.

4 Novelty of Project / Product / Project

The system addresses critical security gaps by monitoring "invisible" BLE signals that traditional network monitoring systems typically overlook. It utilizes a cost-effective distributed architecture of multiple ESP32 "anchor" nodes to provide stable, overlapping coverage and reliable tracking across an office. It integrates real-time passive scanning with a custom Node-RED dashboard to provide administrators with immediate visibility and automated alerts for unauthorized devices.

5 Conclusion or Future Work

The project successfully developed a real-time BLE monitoring system using ESP32 anchors and Node-RED, meeting all objectives for secure device tracking and unauthorized detection in office settings. While effective for presence monitoring, future work will focus on implementing trilateration for precise indoor positioning and advanced signal filtering to mitigate environmental interference. These enhancements will stabilize tracking accuracy and creating a more robust and scalable IoT security framework. Ultimately, this research provides a cost-effective and functional foundation for automated, real-time workspace oversight.

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AUTOMATION SYSTEM USING N8N FOR RULE CONFIGURATION IN CLOUDFLARE AND IP ANALYSIS USING VIRUSTOTAL

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Abstract

With digital transformation, web applications have become essential for communication but remain prime targets for malicious actors. Traditional manual configuration of Web Application Firewall (WAF) rules is insufficient due to high time consumption and human error. This project proposes an automation workflow using N8N to automate the configuration WAF rules and IP analysis. Utilizing a GitHub, Cloudflare and VirusTotal, the system automatically creates rules, defines patterns, scans malicious IP addresses, and sends analysis reports. The system achieves end-to-end automation without duplication of rules or IP addresses. Results demonstrate a 98.2% time efficiency improvement compared to manual operations and 95.9% accuracy of update intervals. This continuous update of predefined patterns ensures constant protection, particularly in cloud environments.

Keywords: Automation, Web Application Firewall (WAF), N8N, Cloudflare

1 Introduction

Web applications have been widely used among individuals, groups, organizations, or even government bodies for wide-ranging business-related activities (Muzaki et al., 2020), turning them into the main targets for cyber threats. The Open Web Application Security Project (OWASP, 2021) identified broken access control, security misconfiguration and identification and authentication failure as top vulnerabilities that may lead to attacks such as SQL injection, Cross-Site Scripting (XSS), and brute force. Hence, applying security mechanism on web applications and minimize their vulnerabilities are very crucial to detect and mitigate threats before significant damage can be done.

Web Application Firewall (WAF) plays a crucial role in providing inspection of the packet traffic transmitted across web applications and blocking potential attacks (Muzaki et al., 2020). However, legacy firewalls often rely on manual and static rule configurations which are time consuming and susceptible to human error, making it vulnerable to the network (Costa et al., 2024). There is an increasing requirement for automated systems that can adapt instantaneously. This project proposes an automation system that integrates cloud-based firewall services with real-time threat intelligence feed to proactively block malicious traffic.

2 Methodology

This project consists of the development of an automation workflow using N8N. The workflow is divided into two parts, which are configuring WAF rules, and analysing and reporting IP reputation. In rules configuration workflow, list of malicious IP addresses is retrieved from a file in a GitHub repository. Then, the existence of rules in Cloudflare is identified by using If Else node. If rules do not exist in Cloudflare, the node output will be false, and rules will be created by inserting the retrieved malicious IP addresses from GitHub and setting its action to block these IP addresses. Otherwise, the output will be true, and the existed rules will be updated using the latest list. In IP analysis and reporting workflow, old list from Cloudflare

and new list from GitHub is compared to extract only newly added malicious IP addresses from GitHub and prevent duplication. These IP addresses are sent to VirusTotal for scanning to initialize its reputation and each result is sent to Gmail for easy monitoring and management.

3 Results / Findings

The findings of this project shows that the system is able to perform an end-to-end automation, starting with retrieving list of blacklisted IP addresses to sending alert of IP analysis report to Gmail, based on its real-time visual indicator of each node and "succeeded" status of execution. Additionally, the automation system successfully updates the rule in Cloudflare without any duplication on both the ruleset and the insertion of blacklisted IP addresses. The time consumption between manual operations and automated operations are also calculated, which shows that automated operations provide higher productivity with 98.2%-time efficiency. Furthermore, this project is also developed to constantly update the rules within 24 hours. With the execution time taken for each trigger for a total of 10 triggers, the result indicates the automation system is able to perform the update with time interval accuracy of 95.9%, which signifies that the system is executed at a precise frequency, leading to consistent and high-quality production output.

4 Novelty of Project / Product / Project

Unlike legacy systems that rely on static rules, this project introduces a proactive, signature-based defence mechanism using a low-code automation engine, N8N. It bridges the gap between public threat intelligence and cloud infrastructure, allowing for real-time IP reputation analysis through VirusTotal before alerting the security teams. This creates a fault-tolerant, scalable framework for web application security that minimizes the time lag between threat discovery and mitigation.

5 Conclusion or Future Work

The project shows how N8N orchestrates and provides an automated method to integrate threat intelligence from an external source into the existing Web Application Firewall (WAF). The developed workflow has the capability of automating the validation process and supporting the dynamic update of WAF rules without the need for human intervention. This project ensures that the web application maintains a high level of consistency and responsiveness toward evolving security threats. To further improve this system, it is recommended to implement enterprise or premium accounts to prevent the limitations of software free plan, alter the structure and logic of Gmail to allow multiple IP addresses scanning reports, and integrate with real-time dashboard and visualization tools for better visualization of threat analysis.

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BEHAVIORAL ANALYSIS OF BLACKHOLE AND GRAYHOLE ATTACK USING DYNAMIC SOURCE ROUTING PROTOCOL IN MANET

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Abstract

MANETs are recognized for their self-configuring, infrastructure-less and dynamic topology features making them highly applicable in emergency response and military applications. These very characteristics however render MANETs vulnerable to serious security threats primarily in the form of internal routing attacks. This paper aims to discuss behavioral analysis of two internal routing attacks namely Blackhole and Greyhole attacks, specifically on the DSR protocol in MANET. DSR is a reactive routing protocol based on source routing and route caching mechanisms that might be used by malicious nodes to conduct such attacks. This research has been conducted in Network Simulator 2, NS-2.35, integrated with BonnMotion to generate realistic node mobility scenarios. DSR performance in normal conditions and under Blackhole and Grey hole attacks has been evaluated using Packet Delivery Ratio, Throughput, Bandwidth Utilization, and Routing Overhead as performance metrics. From the simulation results, it can be inferred that the Blackhole attack affects the network to a greater extent, as it shows the least PDR and throughput by totally dropping the packets. In contrast, the Greyhole attack shows a moderate effect on network performance, as it is more difficult to detect by partly dropping the packets. In comparison to the normal DSR scenario, both Blackhole and Greyhole attacks show increased routing overhead and decreased bandwidth utilization efficiency. From the simulation result, it can also be concluded that the Blackhole attack causes more drop on DSR performance compared to the Greyhole attack, which makes the DSR routing algorithm more vulnerable in an attack-prone environment.

Keywords: MANET, DSR, Blackhole, Greyhole, NS-2

1 Introduction

Mobile Ad hoc Networks (MANETs) are dynamic networks, infrastructure-free, and self-configure. These properties make MANETs very appropriate in emergency responses and military solutions. Nevertheless, their lack of centralized control, and their dynamism leaves them vulnerable to severe security risks, especially internal routing attacks. This paper aims at examining two internal routing attacks such as Blackhole and Greyhole attacks on the Dynamic Source Routing (DSR) protocol. DSR is a reactive routing protocol based on the source routing and route caching, which can be misused by malicious nodes and used to cause performance issues in the networks.

2 Methodology

To carry out this simulation, this research was conducted using a simulation tool for the NS 2.35 version of the network simulator, which integrates the BonnMotion tool to effectively carry out node mobility simulation. To analyze the performance of DSR routing, three scenarios are adopted which are normal scenario, scenario with Blackhole attack, and scenario with Greyhole attack. The key performance metrics chosen for evaluating the protocol scenario are Packet Delivery Ratio, Throughput, Bandwidth Utilization, and Routing Overhead.

3 Results / Findings

The results of the simulation show the effect of the Blackhole attack on the performance of the network by completely dropping the packets. As we can see, the Blackhole attack has the lowest performance in terms of PDR and throughput compared to the Greyhole attack. The Greyhole attack has moderate performance because it drops the packets selectively, whereas the Blackhole attack fails to drop the packets, making it easy to identify the attack. Both attacks increase the routing overhead and bandwidth usage compared to normal DSR performance. Blackhole attacks are more harmful than Greyhole attacks.

4 Novelty of Project / Product / Project

This research focused on behavioral analysis of Blackhole and Greyhole attacks on the DSR protocol in realistic mobility scenarios. It highlights the vulnerabilities of DSR to attack prone environment and provides performance comparisons in detail under different attack conditions.

5 Conclusion or Future Work

In general, the results clearly indicate that DSR is highly vulnerable to internal attacks like Blackhole and Greyhole attacks. Future work would include developing more security mechanisms and enhanced routing techniques for detecting and preventing such attacks and thereby increasing the robustness of routing protocols for MANET.

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OWASP ZAP-BASED DETECTION TOOL WITH RANDOM FOREST & DECISION TREE TECHNIQUES FOR WEB APPLICATION'S CRYPTOGRAPHIC FAILURES

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Abstract

Web applications frequently process sensitive information such as user credentials, personal data, and financial details, making them attractive targets for cyberattacks, particularly those related to cryptographic failures caused by weak, misconfigured, or missing encryption mechanisms as highlighted in the OWASP Top 10. Existing vulnerability scanning tools often generate excessive alerts and false positives, which makes it difficult for security analysts to focus on critical cryptographic issues. This project aims to develop a web vulnerability detection tool that focuses on identifying cryptographic failures by integrating OWASP ZAP with machine learning techniques. A controlled testing environment was created using intentionally vulnerable web applications hosted locally through XAMPP, where passive and active scans were performed using OWASP ZAP. The scan outputs were processed, labelled, balanced, and transformed using TF-IDF feature extraction before being used to train and evaluate Random Forest and Decision Tree models. The performance of the models was assessed using accuracy, classification reports, confusion matrices, and cross-validation. The results showed that the Random Forest model achieved a higher accuracy of approximately 91.49%, compared to around 85% achieved by the Decision Tree model, and demonstrated more stable performance, particularly in reducing the misclassification of non-cryptographic vulnerabilities. A graphical user interface was also developed to visualise prediction results and detected cryptographic failures, improving usability and analysis. Overall, this study demonstrates that combining traditional vulnerability scanning with machine learning enhances the effectiveness of cryptographic failure detection, and future work may focus on expanding the dataset, incorporating vulnerability source information, and exploring more advanced machine learning techniques to further improve detection accuracy.

Keywords: Cryptographic failures, OWASP ZAP, Random Forest, Decision Tree, TF-IDF

1 Introduction

In the current digital era, web applications are widely used in many industries, including banking, e-commerce, healthcare and education (Riberu & Emanuel, 2024). The risk of cyberattacks has increased significantly along with the use of online platforms. Many attackers take advantage of vulnerabilities in web applications, which can result in privacy violations, financial loss and data breaches (Rafique et al., 2015). Cryptographic failures, which are the misuse or lack of appropriate encryption techniques, are one of the main issues that are highlighted in the OWASP Top 10 vulnerabilities list (OWASP, 2021). This project will address this issue by developing a detection tool that is specifically designed to detect the vulnerability of cryptographic failures on web applications that are deployed using OWASP ZAP as the main scanning tool in a secure test environment. This project additionally incorporates a Random Forest and Decision Tree machine learning model to more accurately identify cryptographic vulnerabilities by analysing the scan results of OWASP ZAP.

2 Methodology

A local multi-site testbed using DVWA, bWAPP, OWASP Juice Shop, and scanme.nmap was hosted on XAMPP. OWASP ZAP was used for passive/active scanning. Alerts were exported, cleaned, labelled, deduplicated, and balanced by CryptoFailure either 1 or 0. TF-IDF then changed the alerts text into feature vectors. Models trained were Random Forest and Decision Tree model. Performance metrics were accuracy, confusion matrix, classification report, and 5-fold cross-validation. Streamlit was used for implementation and visualization of the model to provide an interactive GUI.

3 Results / Findings

The performance of the Random Forest Model indicated higher levels of accuracy during the tests which is 91.49% and stable cross-validation performance in comparison to the Decision Tree Model which is 85%. In both models, confusion matrices were also generated, showing lower false positive rates for non-crypto related alerts. Additionally, the GUI has successfully shown record specific predictions and enhanced the table focusing on specific failures related to cryptography.

4 Novelty of Project / Product / Project

This project combines a generic open-source scanner which is OWASP ZAP with a supervised machine learning classification approach, focusing this approach on cryptographic failures specifically. This should enhance the potential for relevant analysis and improve the signal-to-noise ratio for encryption related vulnerabilities. The use of Streamlit for the GUI combines automation principles with human evaluation capabilities.

5 Conclusion or Future Work

The proposed ZAP and machine learning integrated solution has successfully addressed the project goal, providing better detection and prioritization with Random Forest compared to the use of Decision Tree. Future work would include exploration of a wider diversity of datasets which more real-world targets, exploration of adding additional columns such as source URL, endpoint, etc., as well as exploration of using this solution in a live environment.

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